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The NASA Scientific and Technical Information Program

Exploring Challenges, Creating Opportunities

Division of Information
Resources Management

Office of Management
Systems and Facilities

National Aeronautics and
Space Administration



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On the cover: A PHSCologram (pronounced "skol-o-gram") that simulates a hypersonic vehicle travelling at Mach 12.4. This unique illustration shows pressure on the vehicle's surface and on a cross section of the shock wave. Magenta is the highest pressure, blue is the lowest.

For the story behind this PSHCologram, and other STI Program case studies, see "The Program in Practice" (pages 13-21).

Table of Contents

1 **Message from the Director**

2 **The National Policy Scene**

5 **The R and D Information Cycle**

9 **Products and Services**

13 **The Program in Practice**

22 **Domestic Operations**

- Support Operations
- NASA Centers
- CENDI

32 **International Operations**

- Overview
- AGARD
- Case Studies

37 **Agenda for the STI Program NASA-Wide**

- User Services and Outreach
- Information Services
- Additional Developments

42 **Technology Transfer**

44 **TQM Chronicle**

49 **Glossary of STI Terms**

50 **Key Acronyms**

52 **STI Program Highlights**

Inside back cover **STI Program Management Team and STI Council**

Throughout 1992, events on many fronts augured well for the continued success of the NASA Scientific and Technical Information (STI) Program and those we serve.

Early in the year, new directions began to evolve at every level of NASA as we started to reexamine and, where appropriate, reinvent this agency.

A cross section of the STI Program participated on the Red and Blue teams engaged in this important work. This year's theme, "Exploring Challenges, Creating Opportunities," reflects the innovative spirit the NASA STI Program brought to this critical process and to all our work in 1992, as we made less do more for NASA...and the nation.

Throughout the year, we witnessed the emergence of a new national level policy focus on STI and STI-related issues. These developments validate the importance of information in national science policy and in competitiveness issues. They also present exciting opportunities for the NASA STI Program and other Federal STI managers.

In the coming months and years, the NASA STI Program will continue working through established intra- and interagency mechanisms to raise issues that help us refine and upgrade the products and services we bring to our expanding user community.

In May 1992, a NASA committee chaired by the Deputy Associate Administrator, Office of Aeronautics and Space Technology, formally endorsed the value of the NASA STI Program to NASA and to the aerospace community. The committee's findings reinforced the conviction that one key ingredient of superior research and development (R&D) is the sharing of knowledge gained through earlier research.

This sharing of knowledge is the basis of the STI Program's partnership with NASA researchers. Our infrastructure of people and systems remains carefully aligned to acquire STI worldwide, add value to it, then disseminate new and enriched STI back to our users.

I invite you to examine pages 5-8 for a more complete look at the NASA R&D information cycle. Then we offer you a broad sampling of our products and services. The case studies in "The Program in Practice" point to the diverse talents and skills offered by STI Program professionals. As our case studies demonstrate, we continue to pursue aggressive strategies that produce "faster, cheaper, better" results for NASA researchers.

International Space Year (ISY) was the ideal backdrop for 1992. This was the year when the world took its first steps toward a truly global space program aimed at producing global benefits. In that same spirit, the Program made substantial gains toward strengthening ties with STI partners worldwide.

To serve our users better, we made significant progress in upgrading operations at the Center for AeroSpace Information (CASI). We continued to explore options for an even more comprehensive use of new technologies NASA-wide. Our Technology Focus Group is working this issue with the NASA Centers. We also began to develop and implement a multiyear capital investment plan to modernize our information systems and guide our transition to optical and digital technology.

Much NASA research has commercial value as well as scientific merit. It can create jobs, raise standards of living, and improve competitiveness. In these pages, we offer insights on the multifaceted contributions of the NASA STI Program to technology transfer.

While the NASA STI Program accomplished much in 1992, there is still much left to do. New approaches might be required to position us for greater success in an increasingly demanding information environment. That perspective underlines our commitment to Total Quality Management, or TQM, a methodology that incorporates a dedication to continuous improvement.

My optimism is fueled by the belief that the Program is on the right course...and by my confidence in the talents and abilities of the exceptional men and women who comprise the NASA STI Program nationwide.

As we embark on another challenging year, we do so with deep appreciation for the guidance of the STI Council and the ongoing support of our users. •



Gladys A. Cotter
Director, NASA Scientific and Technical Information Program

The National Policy Scene

As the 1990s unfold, dramatic developments in the national and international arenas are helping to shape a new set of economic and geopolitical realities.

Some of the more promising opportunities for the NASA STI Program stem from the growing national interest in economic competitiveness, education, and the environment.

The increasing importance of these issues is not surprising. The Cold War has ended. The global marketplace is at hand. From the STI perspective, the ongoing revolution in information technologies and user expectations pervades, and influences, these factors as well.

In 1992, these developments converged to produce a year of great significance to the NASA STI Program and its users. Influences at the policy level of our government yielded unprecedented support for the view that STI is a national resource to be valued...and cultivated.

FCCSET STI Ad Hoc Group

On October 27, 1992, President Bush's Science Advisor, Dr. D. Allan Bromley, sent a memo to all members of the Federal Coordinating Committee on Science, Engineering, and Technology (FCCSET) inviting member agency participation in an Ad Hoc Working Group on STI. For the first time since the mid-1970s, the Executive Branch had formally identified STI as a national concern meriting the attention of the White House Science Office.

Senior Administration officials from more than 20 independent agencies support the science mission in the U.S. through FCCSET cooperation. The FCCSET structure operates under the Office of Science and Technology Policy (OSTP).

The objective of the FCCSET STI Ad Hoc Working Group, as stated in Dr. Bromley's memo, is "to review and assess current Federal approaches to dealing with scientific and technical information and recommend necessary modifications."

Representatives from NASA and three other agencies (OSTP, Office of Management and Budget (OMB), and Health and Human Services) participated in a planning group that preceded the formation of the Ad Hoc Working Group. The planning group explored ways to identify key issues, including the principles underlying STI, a taxonomy of STI flow, and a case study approach to manage information. STI managers also briefed the planning group on issues facing their programs.

Ultimately, the Ad Hoc Working Group's efforts could lead to recommendations for legislation, Executive Orders, or other mechanisms aimed at achieving policy improvements.

NREN

The passage of the High Performance Computing Act in November 1991 was a major step forward in the creation of an infrastructure for the National Research and Education Network (NREN). NREN is one of the Act's key components.

NREN is intended to revolutionize the ability of U.S. researchers and educators to carry out collaborative activities. NREN's telecommunications infrastructure substantially expands and upgrades the previously interconnected array of mostly scientific research networks. Through it, the nation's research centers and universities are connected by a high-speed computer highway.

NREN is both an existing network and a vision. In July 1992, (then) Senator Albert Gore (D-TN) introduced the Information Infrastructure Act of 1992. This bill provided additional funding for NREN and targeted libraries as one specific area for development. This legislation did not pass, but it is likely to reemerge in some form in 1993.

The incoming Clinton/Gore administration hopes NREN will serve as a model for a broader network that will make electronic information services ubiquitous. Just as the NASA STI Program monitored the progress of the High Performance Computing Act, we will continue to track any succeeding legislation to ensure our users reap maximum benefits from these pioneering developments.

OMB Circular A-130

In 1992, the Office of Management and Budget distributed two phases of proposed revisions to its 1985 Circular A-130, "Management of Federal Information Resources." A-130 is the cornerstone of Federal Information Resources Management (IRM) policy. The revisions delineate new policy on, among other things, how Federal agencies should manage information and provide public access to it. The circular refers to the broadest range of government information and covers numerous areas beyond STI.

A-130 was yet another example of the emerging national policy focus on STI and STI-related issues.

Database Access

As A-130 demonstrated, Federal agencies are rethinking the priority placed on providing government information to the public, as well as procedures for information exchange among agencies. Where appropriate, members of the NASA STI Program are helping to formulate policy that is compatible with the interests of both Program users and the public at large.

The Interagency Public Access Group is composed of information professionals from a cross section of Federal agencies. The NASA STI Program is among the participants. One of the



Among the representatives discussing STI exchange issues in Moscow were: Wallace O. Keene (left), Director, NASA IRM Division; Professor Eugene Ruzhitsky (center), Professor, Chief of Information Division, Central Aerohydrodynamics Institute (TsAGI); and Dr. Victor Presnukhin, Director, All Union Research Institute of Interbranch Information (VIMI).

group's key concerns is to ensure that the public access policies developed by various Federal agencies are consistent with each other and with Federal policy generally, while allowing latitude for differences based on each agency's characteristics and mission. A NASA STI Program representative heads up a designated subgroup on pricing and budgeting.

As for database access between agencies, the recent experience of the Federal Emergency Management Agency (FEMA) in gathering and analyzing claims data related to Hurricane Andrew revealed a need to streamline policies on interagency database access.

The Interagency Information Resources Management Infrastructure Task Group (IIITG), an outgrowth of the Federal Information Resource Management Policy Council (FIRMPOC), recently established a Database Services Panel. This panel is addressing interagency information resource management issues, including STI concerns. The STI Program was an original member of this panel and will continue to participate in panel activities in the months ahead.

NFAIS Policy Committee

The National Federation of Abstracting and Information Services (NFAIS) is a membership organization that serves the world's information producers, vendors, suppliers, and users. For more than 30 years, NFAIS has guided the global information community through education, research, and publication. Gladys Cotter, Director of the NASA STI Program, is a member of the NFAIS Board of Directors.

The NASA STI Program also has representation on the NFAIS Information Policy and Copyright Committee (IPCC). The IPCC deals with questions of data availability, licensing, fair use, and a variety of other copyright-related matters. The committee brings a national and, when needed, an international perspective to its activities.

New technologies, such as CD-ROMs, are currently one area under discussion. For instance, the IPCC wants to ensure that CD-ROMs submitted to the Library of Congress from the U.S. Copyright Office retain the licensing and distribution rights secured through the copyright process.

Russian Activities Update

Perhaps no region of the world demonstrates the new geopolitical realities of the 1990s better than Russia and the recently formed Commonwealth of Independent States. Developments in this area offer a variety of exciting, unprecedented opportunities for NASA and the NASA STI Program.

In March 1992, a team of NASA STI experts—led by Wallace O. Keene, Director, NASA Information Resource Management (IRM) Division—visited 10 Russian institutes to explore the possible exchange of STI. While the American team found a great openness on the part of the Russians, both trade and organizational impediments to a free exchange of STI remain. Efforts to resolve these differences, including intellectual property rights, are continuing.

In June 1992, Presidents Bush and Yeltsin signed the "Agreement Between the United States of America and the Russian Federation Concerning Cooperation in Exploration and Use of Outer Space for Peaceful Purposes."

This groundbreaking agreement highlights numerous potential areas of U.S./Russian cooperation. Several of the bilateral efforts identified in the agreement were already in progress, including working groups in such areas as space biology and medicine, solar system exploration, and space astronomy and astrophysics. The depth and diversity of these activities reinforce our awareness that Russia has been, and remains, an exceptionally rich source of scientific and technical information.

Since then, the NASA STI Program has started negotiations to obtain data from the Central Aerohydrodynamics Institute (TsAGI). TsAGI, one of the largest centers of aeronautical science in the world, has played a leading role in the development of all Soviet commercial, cargo, and military aircraft.

In the months ahead, the NASA STI Program will continue to aggressively pursue talks aimed at the acquisition of Russian STI. After the proper protocols have been established with TsAGI, the NASA STI Program will approach other Russian organizations to solicit data for inclusion in the NASA STI Database files. •

NASA Committee Endorses Importance of STI Program

In the fall of 1991, the Associate Deputy Administrator, Samuel Keller, requested the formation of a committee to review and evaluate the agency's management of scientific and technical information activities. Dr. Robert Rosen, Deputy Associate Administrator, Office of Aeronautics and Space Technology, was appointed to chair the committee.

Committee members, as selected by Dr. Rosen, ensured a balanced perspective on the agency's STI activities.

Designated the Scientific and Technical Information Activities Committee, the group was particularly interested in reviewing NASA's current STI capabilities and requirements ...and whether the agency was meeting those requirements in the most cost-effective manner.

The Committee's findings, released in spring 1992, included the following:

- NASA's STI activity has great value to NASA, universities, industry, and other government agencies. However, improvements in service are desired.
- The STI Program should be directed to develop and implement a multiyear capital investment plan that will (a) modernize computer systems and (b) transition to optical digital image technology. Additionally, the agency should provide the funds for the plan.
- Productive changes have been made by recent STI management; NASA senior management should provide strong support to the STI Program and management.
- Significant changes have taken place in the international arena that affect the information exchange arrangements with foreign agencies. The STI Program has to look carefully at ensuring international technology transfer parity.

The Committee's overall recommendation was that the agency should continue to fund the program at its current level (adjusted for inflation) for operations and provide a separate line item for modernization funding.

In May 1992, in a separate briefing by Dr. Rosen to the STI Council, he noted that "the STI Program Director, Ms. Gladys Cotter, and her team are doing an excellent job and management ought to support that with funding." •

NASA STI Program functions are tied to the information that supports *and* results from NASA R&D.

Here is a look at NASA researchers and STI Program professionals as they perform their interdependent roles in the R&D information cycle.

The Information Cycle Begins

One basic principle powers the information cycle: Every major aerospace achievement builds on earlier gains. Lessons learned answer some questions, but raise others, spurring further research...and new discoveries.

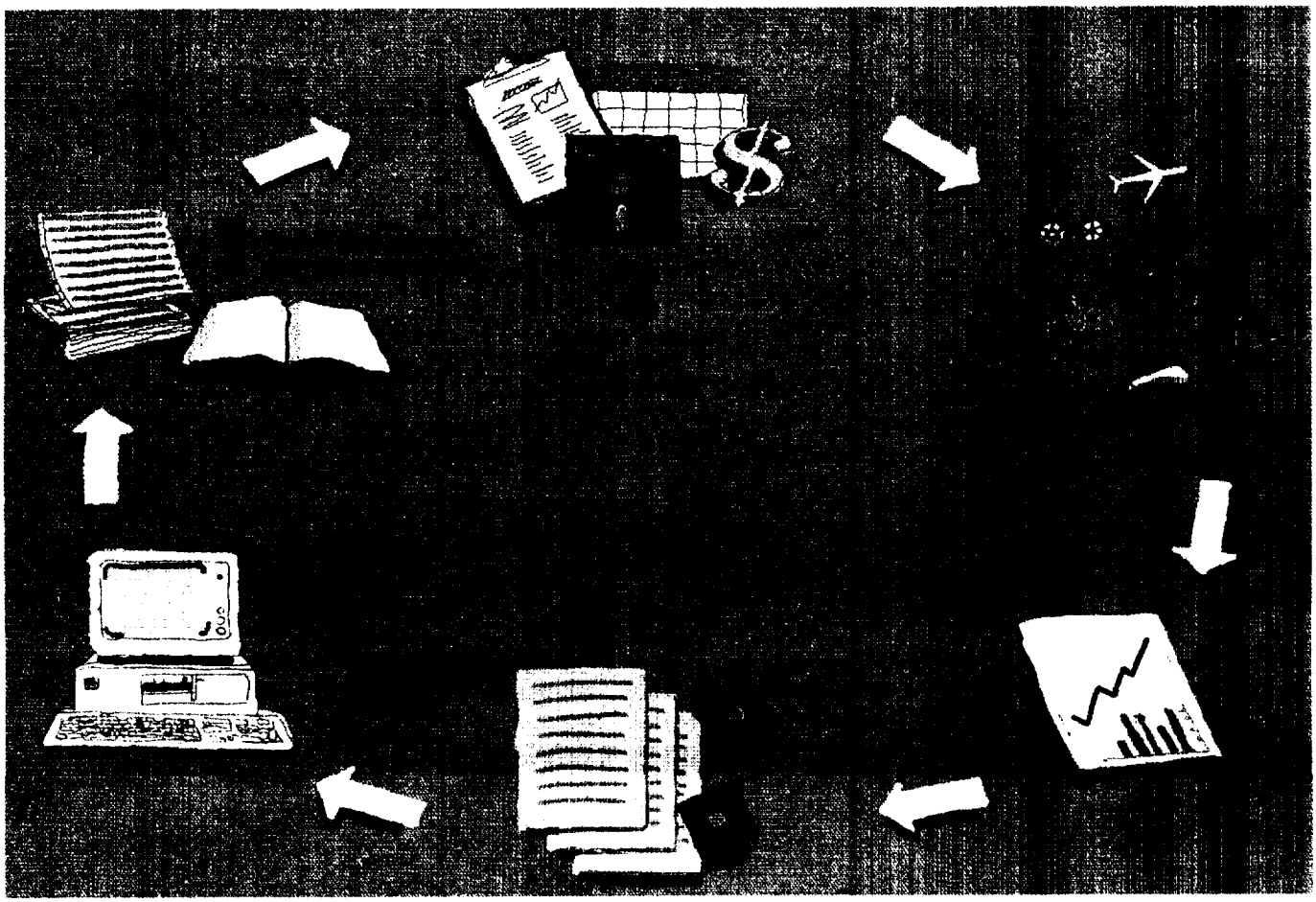
It's difficult to exaggerate the importance of the groundbreaking ideas that drive NASA R&D. With approximately 90 percent of its funds directed toward research and engineering, the agency's commitment to R&D is enormous.

But while *ideas* provide the spark, *information* sustains the fire. And at NASA, that information is available through the NASA STI Program.

The need is fundamental. Research begins with discovering and examining the existing knowledge. Previous work provides the starting point for new projects. In the competitive and costly multidisciplinary arenas of aeronautics and space science, the need to streamline this examination process becomes paramount.

Among those who rely on the Program's varied capabilities are NASA researchers and managers and their contractors, other government agencies and their contractors, universities in the U.S. and around the world, international partners, and the general public in the U.S. and abroad.

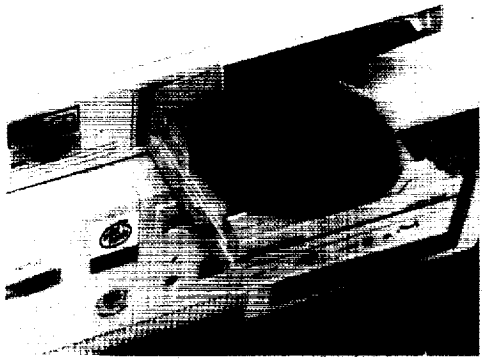
Using both traditional and advanced technologies, NASA STI professionals identify and provide the STI that



What Is STI?

Scientific and technical information, or "STI," refers to *basic and applied research results from the work of scientists and engineers.* It is found in two forms. The first, referred to as "primary STI," includes new theory and information presented in the form of text, numeric data, and images. Primary STI is the result of experiment, observation, or computer modeling. It includes research documents, such as the technical reports in the renowned NASA technical report series. Primary STI may be further transformed and recorded in a variety of media, including print, digital, video, and magnetic.

Secondary STI explains or summarizes primary STI. Secondary STI includes the abstracts and bibliographic records in NASA's STI Database. *STAR* (Scientific and Technical Aerospace Reports), the monthly journal containing announcements of worldwide R&D reports, is an example of secondary STI. Such "information about information" serves as a tool for identifying primary STI...and for sorting out which items researchers want to examine in more detail.



Researchers will soon be able to use the Program's new ASTRO/CD (Aerospace Scientific and Technical Research On CD-ROM) to search the major bibliographic files entered into the NASA STI Database during the past five years.

Their requirement for STI is comprehensive. At NASA, the STI Program captures and distributes the documented results of NASA R&D activities from *every* area of the agency's comprehensive mission, as well as related STI from international sources, journals, conferences, patents, and the like. •

researchers need. Whether it's a published report or perhaps customized updates to studies in progress, the NASA STI team can produce and deliver the required information in a variety of formats.

Researchers may choose from NASA STI print publications, microfiche, online services, and optical media to discover a wealth of information. Each search vehicle serves as a reliable tool for harnessing NASA's STI—**the largest collection of aerospace STI in the world**.

The cornerstone of this collection is a powerful database of approximately three million records on aeronautics and space science. Database topics cover a surprisingly wide variety of theoretical and applied fields, including mathematics, physics, geosciences, life sciences, engineering, chemistry, and computer sciences. Geographically, coverage is wide-ranging as well, with material originating in the U.S. as well as in more than 50 countries worldwide.

Online computer searches of the STI Database through an information retrieval system called the NASA REsearch CONnection, or RECON, are common. RECON offers users many options. For instance, researchers can perform immediate literature searches on virtually any topic of interest. Or, they can request the delivery of new STI in their areas of interest as it becomes available.

Currently, the Program has 1,500 registered organizations with more than 3,800 individual users, including 970 RECON users performing more than 90,000 searches annually. This number does not include searches performed by the general public by using the subset of NASA STI records available through other database vendors.

The STI Database is available worldwide through dial-up access via networks like the Internet, NASA internal networks, and commercial networks. Access is as near as a personal computer and a telephone.

Using one of these access methods, a researcher can query the Database by such aspects as subject, keyword, author, contract number, or date to find specific citations. The inexperienced user can neither disrupt the system nor interfere with other users.

Through agreements with organizations in the U.S. and abroad, citations to NASA STI Program documents are accessible from multiple sources, including the European Space Agency (ESA), DIALOG (a publicly available information service), the National Technical Information Service (U.S. Department of Commerce), the Government Printing Office, and National and Regional Technology Transfer centers managed by the NASA Technology Utilization Program.

The STI Program also provides access to a variety of other databases around the world, creating an unrivaled aerospace information network.

Using the computer to search and locate references, and the online abstracts to evaluate the potential

usefulness of a document, a researcher can select items to examine in full.

To obtain full-text documents, users often use local library services and simply request them. However, many document orders are sent online through RECON directly to the Center for AeroSpace Information (CASI). Telephone, mail, and fax orders are also accepted. CASI sends out orders for delivery by regular mail, express mail, or fax.

The Cycle Continues

Researchers are looking for information that will make a difference—that supports or challenges assumptions or other information in hand and that provides a theoretical basis for further work and analyses. They are also ensuring that their proposed project has not been done before, so they can proceed with research and funding requirements.

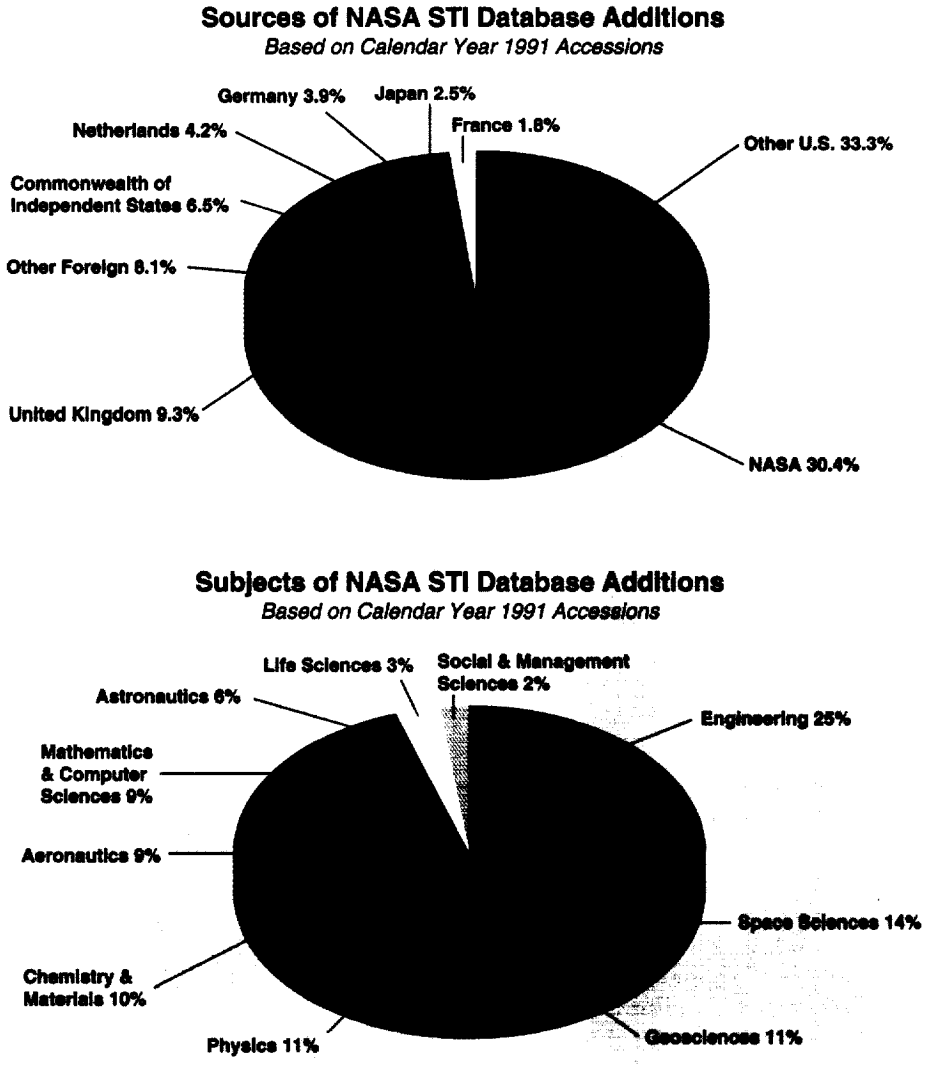
The results of their own research must then be published to join the store of knowledge available to the community. STI Program experts in such areas as editing, graphics, and photography help researchers prepare those results for publication in a wide range of media, including the NASA technical report series and journal literature.

Value-Added Information Processing

NASA technical reports and patents, research reports from other U.S. Federal government agencies and foreign agencies, NASA contractor reports, and other report literature are actively collected by the STI Program at the CASI. They arrive in all forms: paper, microfiche, computer tapes, and recently, multimedia formats.

The Program also reviews more than 1,500 open literature sources (journals, published conference proceedings, etc.) for articles and papers of interest to the aerospace community. We actively follow any leads to additional relevant publications from worldwide sources.

When documents and electronic records arrive, they're checked to make sure they're not already in the Database *and* that they're relevant to NASA's research and development interests. Each document that is selected is assigned to a subject category—and any distribution limitations are noted (see box on page 8).



Sources and subjects of NASA's STI Database are carefully aligned with NASA's wide-ranging R&D activities.

Next, through a cataloging procedure the bibliographic details of each document are entered into a developing STI Database record. These details include such data as authors, title, report numbers, pages, and journal citation.

The next steps are abstracting and indexing. An abstractor either writes an abstract or reviews and edits, if necessary, the abstract already provided. (Use of author-provided journal abstracts is subject to copyright limitations.) An indexer then assigns each document a set of indexing terms that describe the subject content of the document. This step is supported by Machine-Aided Indexing (MAI).

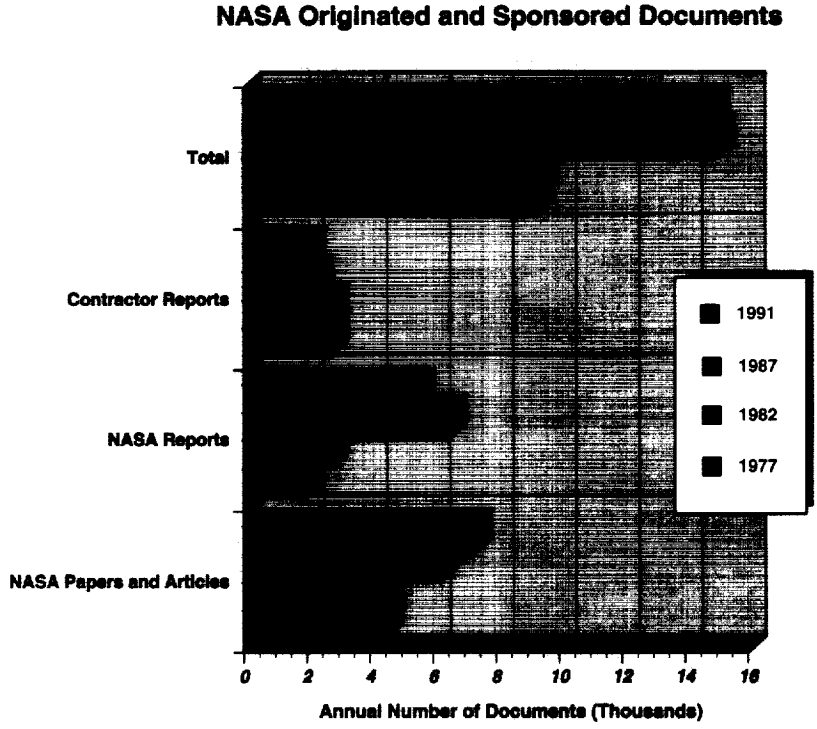
The abstract and index terms are added to the bibliographic record along with other information such as document availability, distribution limitations, and price. The record is then ready to be added into the STI Database.

The last step in the process is a final quality control (QC) check. Although quality is checked at each step along the way, this final check ensures that this produce, like other products of the STI Program, meet user expectations.

At CASI, incoming NASA-supported reports go through one final step—they are filmed to produce microfiche copies, according to NASA micrographic standards. These are distributed to NASA Centers and provided to other organizations and registered CASI users.

This final function completes the R&D information cycle. Value-added processing makes it possible for future aerospace researchers to access new STI easily...and to achieve new R&D advances by building on earlier insights. •

See page 49 for a glossary of STI and STI-related terms mentioned in this chapter and elsewhere in this publication.



NASA originated and sponsored documents—individually indexed and recorded in the NASA STI Database—include journal articles, conference proceedings, and technical papers.

Handling Sensitive Information

NASA policy mandates the widest practicable and appropriate dissemination of the agency's R&D efforts. In accordance with that policy, sometimes distribution restrictions must be imposed on STI to protect new technology from international trade, to comply with Federal export laws, or both.

These restrictions are outlined in a NASA STI Program publication, *NASA Scientific and Technical Information Handbook: Documentation, Approval, and Dissemination.* Officials in charge of Headquarters Program Offices and Directors of Field Installations are responsible for ensuring that all personnel who act as NASA Project Officers and Technical Monitors follow the *Handbook*'s provisions.

Authority for these provisions rests in The National Aeronautics and Space Act of 1958, as amended; the Export Administration Act of 1979; the Arms Export Control Act; 35 U.S.C. 205, as implemented by the Federal Acquisition Regulation Subpart 27.3; and the Presidential Policy Paper on National Space Strategy (August 15, 1984).

In short, programs and policies are securely in place at NASA to ensure that sensitive or classified STI does not fall into unauthorized hands. •

The following is a representative selection of the family of products and services the STI Program offers its users.

Products

STI Program products come in two forms—"primary" and "secondary" STI (see box on page 6). Primary STI includes the NASA technical report series.

NASA Technical Report Series

The series includes: *Conference Publications* (CP), *Contractor Reports* (CR), *Reference Publications* (RP), *Technical Memorandums* (TM), *Technical Papers* (TP), *Technical Translations* (TT), and *Special Publications* (SP).

Special Publications

SPs are narrative summaries on areas of particular scientific or technical interest, or chronologies of NASA missions or eras.

SPs are sponsored by NASA program offices and written by NASA or NASA contractor scientists, engineers, and managers. Frequently, they contain detailed descriptions, illustrations, photographs, and charts from the projects they describe.

Among the most popular titles are *This Island Earth, Apollo Expeditions to the Moon, Engines and Innovation: Lewis Laboratory and American Propulsion Technology, First Among Equals: the Selection of NASA Space Science Experiments,* and *Space Resources.*

"Secondary" STI, or information about information, covers a broad range of NASA STI Program products. These include...

Announcement Publications

Announcement publications are published regularly by the NASA STI Program. Many have annual cumulative indexes.

Two of the best-known and most popular announcement publications are *STAR* (Scientific and Technical Aerospace Reports) and *IAA* (International Aerospace Abstracts). These companion abstract and index journals contain announcements of R&D reports and open literature in 76 aerospace-related categories. *STAR* covers worldwide, publicly available report literature on aeronautics and space science, and *IAA* covers the same areas in the "open literature," including scientific and trade journals, books, and conference papers.



NASA STI products cover a variety of media, including print, video, and optical.

Current Awareness Products

These publications are designed to keep readers aware of the latest additions to the NASA STI Database.

SCAN (Selected Current Aerospace Notices) and *Currents* are citations and abstracts of R&D reports and journal articles distributed soon after their availability online in the STI Database. Entries are announced in 191 aerospace-related topic areas in *SCAN*. *SCAN* topics are available to registered users by subscription. Currently, some 900,000 copies of *SCAN* are distributed annually.

Updates is another customized current awareness product. For *Updates*, reference analysts perform searches relevant to NASA contracts and offer

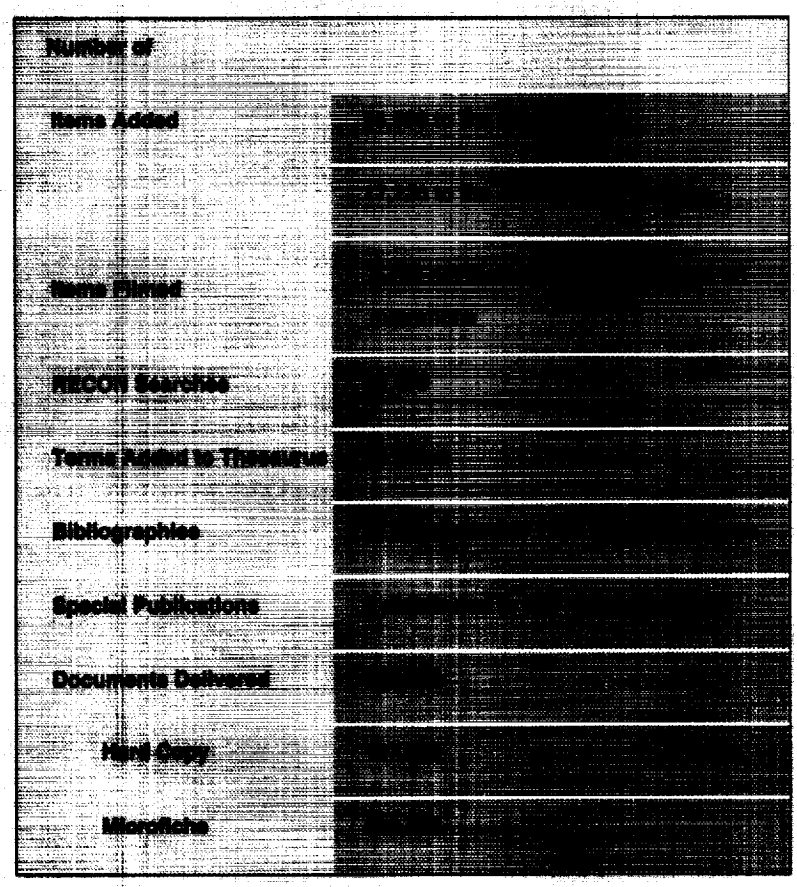
NASA Access Help Desk Introduced

Located at the CASI, the NASA Access Help Desk offers users quick, courteous assistance on a wide variety of subjects, including Program information, registration, document ordering, reference/search assistance, training, and acquisitions.

Users with questions covering any of these areas, or with specific questions about NASA STI Program products and services, can:

- **Phone** the NASA Access Help Desk at (301) 621-0390
- **Fax** questions to the NASA Access Help Desk at (301) 621-0134
- **E-Mail** questions via the Internet to help@sti.nasa.gov
- **Write** to: NASA Access Help Desk
 NASA Center for AeroSpace Information
 800 Elkridge Landing Road
 Linthicum Heights, MD 21090-2934

A Sampling of Program Productivity—Fiscal Year 1992



continuous, automatic monthly search output to the principal investigators and technical monitors of the contracts. Currently there are 620 current awareness profiles and 8,000 *Updates* listings. NASA Center libraries offer a similar service to their patrons.

In addition, *Updates* is transmitted electronically to five NASA Centers: Ames, Goddard, Headquarters, Lewis, and Marshall. The publication is printed and distributed locally at each of these locations, thereby streamlining dissemination and decreasing postage costs. In 1993, testing will begin at Dryden and Langley on transmitting *Updates* directly to the end user's workstation. The end user will then be able to review the publication online and, if desired, print it out at the workstation.

STI Handbooks and Tools

A series of print products give users access to the tools used for processing records into the NASA STI Database. Included in this series are:

► *NASA Thesaurus*, updated constantly and produced triennially in three volumes. Represents the controlled vocabulary used to index records in the NASA STI Database. The three volumes are Hierarchical Listing, Access Vocabulary, and Definitions

► *Corporate Source Authority List* (CSAL), lists the accepted names and locations of corporate entities and matches the names to their corporate source codes

► *Corporate Source Authority List Updates*, periodic updates to the CSAL

► *Acronym Dictionary*, a compilation of acronyms used in the Database

► *Combined File Postings Statistics*, a report of the frequency of usage for index terms assigned to records.

Continuing Bibliographies

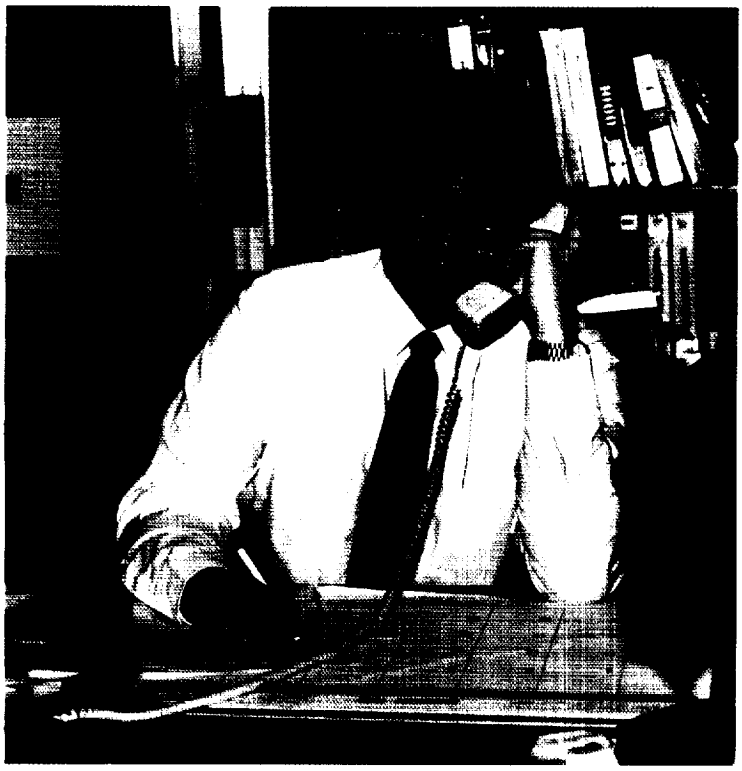
These include a series of print products produced at frequencies varying from monthly to annually listing citations from the Database in particular subject areas of interest. Examples are the monthly publications *Aeronautical Engineering* and *Aerospace Medicine and Biology*.

Special Bibliographies

Bibliographies that are produced as one-time products or those issued irregularly are known as Special Bibliographies. These generally are produced on topics of current interest, such as *Implementing Total Quality Management*. Often, they are created at the request of a particular NASA program office or code.

RTOPS

Research and Technology Objectives and Plans Summary or *RTOPS* is an annual guide to NASA-sponsored research in progress. It represents the NASA research and technology program for the current fiscal year. *RTOPS* includes the technical summaries and



Researchers are just a phone call away from prompt, courteous assistance by NASA STI Program staff.

indexes of all Research and Technology Objectives and Plans submitted by the NASA Centers to the NASA Headquarters Office of Aeronautics and Space Technology for management review.

Other STI Program publications include the *STI Bulletin*, a newsletter sent to all registered users of the STI Program; and *Index to NASA News Releases and Speeches*.

Services

Reference and Literature Services

In response to user inquiries, STI Program staff perform searches on the NASA STI Database, the ARIN Database, or outside databases.

ARIN—the Aerospace Research Information Network—is an online catalog providing author, title, subject, and keyword access to the nearly 380,000 entries from the 14 NASA-affiliated libraries. ARIN is an integrated information system that automates all functional areas of NASA libraries, including shared cataloging, bibliographic searching, circulation, interlibrary loan, and management information. Currently, the Program has over 700 ARIN registered users.

Recognizing that NASA researchers often need to perform searches outside of regular business hours, beginning early in 1992 access to the NASA STI Database and the ARIN Database was extended. Operating hours are now 8 a.m. to midnight, Eastern Standard Time on weekdays—a 33 percent increase in the availability of both databases. In late 1992, in another move to improve service to STI Program users, both databases became available via the Internet.

Other reference and literature services performed by the STI Program include:

► Telephone calls and letter requests—received from users asking for assistance in identifying or order-

STI Program at the NASA Centers

Program professionals at NASA Centers interact with researchers to generate much of the Program's STI. In addition, each Center is responsible for ensuring that reports from NASA employees and contractors are properly reviewed and entered into the STI system.

Program professionals at the Centers offer researchers the products and services outlined in this chapter. They also provide related services—with the number and mix of those services tailored to each Center's needs. Activities typically include library services; publishing; graphics and exhibits; photography; reproduction; and multimedia.

Here is a generic look at each of these areas.

Library Services—NASA STI Program librarians use a range of bibliographic tools (print, online, CD-ROM) to help researchers locate and retrieve appropriate STI.

Publishing—Whether researchers want to publish in the NASA technical report series, in professional journals, or in other publications, STI Program technical writers and editors work closely with researchers, shepherding new STI through the editing, review, and production stages. Often these processes dovetail with the work of STI Program graphics professionals.

Graphics and Exhibits—Graphics and exhibits experts handle such diverse duties as publication design and illustration, the creation of computer graphics, and exhibit design and production.

Photography—Still photography runs the gamut, including publicity and conference shots, official portraits, passport photos, macrophotography, time-lapse photography, and aerial photography.

Reproduction—Services include printing, copying, duplicating, and miscellaneous reproduction assistance, such as microfiche, microfilm, slides, and microfilm "blowbacks" (paper copies).

Multimedia—Media include motion picture films, videos, and new multimedia formats. Some Centers, for instance, are developing multimedia technical reports. •



STI Program staff members are always available to help researchers with literature searches and information retrieval.

ing documents

► Search assistance inquiries—responses to users with questions about the functional operation of one of the STI Program's online systems. Answers are often instructional in nature.

To support reference and literature services, the Program staff mails each week hundreds of sets of printed output from searches performed by users.

Training

Training classes in using RECON retrieval software are offered at basic and advanced levels.

In basic training, students learn how to conduct simple look-ups and how to develop RECON search strategies. Some knowledge of using online retrieval systems is assumed.

In advanced training, students learn RECON's more complex and sophisticated searching features.

Training classes are offered in the use of the ARIN system for both the cataloging and circulation functions.

Translations

The STI Program coordinates the translation into and out of English of documents written in any of 34 principal foreign languages (translation of other languages is available on demand). The staff also attempts to locate English-language versions of foreign language documents. Translations can be delivered to users by fax, electronically, or by mail. Rush deliveries are possible, too.

The Program recently put the Library of Congress's National Translation Center database online. This database tells users which non-English language documents have already been translated. Now users can order those translations directly from the National Translation Center—rather than having the STI Program search this Library of Congress database, then place the order for users.

User Assistance

The Program receives a wide variety of user inquiries, most often by phone. Program professionals offer users prompt assistance in such areas as registration, document ordering, and reference/search concerns.

Microfiche and Hardcopy Document Delivery Services

Document requests are filled by the CASI in one of three ways: by providing the original document; by providing a hardcopy reproduction of the document; or, by supplying the document on microfiche (microfiche for archiving and distribution is produced at the CASI).

When the CASI can't provide a document, the user requesting the document is referred to other suppliers. Usually this happens when we are not authorized to distribute the document in question.

Document Distribution Subscription Services

Copies of new research reports are available on an annual subscription basis through the Automatic Document Distribution Service (ADDS). In 1992, ADDS distributed nearly 72,000 copies of documents annually to our users (3,735 in paper copy and 68,110 in microfiche). The reports distributed are from a combination of subject divisions and categories that cover all aspects of aerospace interest...from aeronautics through the social sciences.

A Standing Order Service is available for users who prefer a pay-as-you-go approach. Instead of paying an annual subscription fee for documents—as in ADDS—the user is sent a monthly invoice for items received.

Current Awareness Services

Current awareness services include MANAGERS, an online service. MANAGERS may be executed by RECON users at any time. Each week, STI Program staff members select 20 citations of interest to NASA managers, then make them available online. Through MANAGERS, NASA managers receive these citations several weeks before they are published in *STAR*. Managers merely need to enter the command "query execute managers (nahq)" to initiate the service. At that point, RECON takes over and selects the 20 citations, which the user can display on screen, print locally, or capture to disk (download).

SCAN (Selected Current Aerospace Notices), the current awareness product mentioned earlier, is also available as an online service. •

The Program in Practice

The NASA STI Program acquires, processes, and distributes scientific and technical information. In practical terms, these duties can involve such diverse activities as performing literature searches, editing technical publications, and providing exhibit design services. Following are several examples of these efforts.

Art, Science, and Economy Displayed at Ames

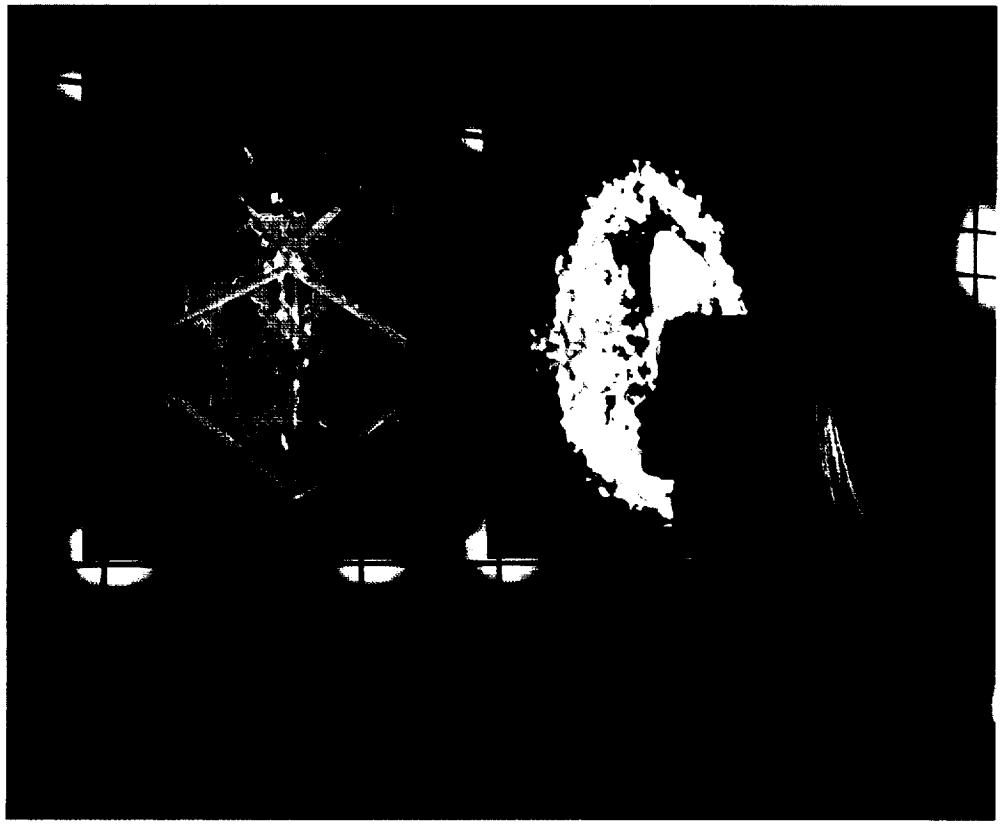
In today's "faster, better, cheaper" environment, providing high-quality STI at low cost is more than a goal. It's an agency mandate. Here's an instance from the Ames-Moffett Technical Information Division (TID) that embodies the new NASA approach.

Among TID's broad range of STI professionals is an experienced exhibit design staff. Late in 1991, David Morse, Public Services Manager, External Affairs Office at Ames, asked TID to create an attractive, low-cost design for a PHSCologram (pronounced "skologram") exhibit coming to the Visitor Center.

Ames presented the touring exhibit "Science in Depth" PHSCologram in cooperation with the $(Art)^n$ Laboratory at the Illinois Institute of Technology and the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago.

$(Art)^n$ and EVL are collaborative groups of scientists, engineers, and artists who are dedicated to the fusion of art and science. The medium in this case—the PHSCologram—is a blend of photography, holography, sculpture, and computer graphics. A PHSCologram is one of the only digital forms of 3-D hardcopy, produced in full color, that is entirely computer-generated.

The exhibit consists of a series of 43 PHSCologram lightboxes, each dedicated to a specific science topic. Many, it turns out, were inspired by research conducted at Ames. General subject areas include aeronautics, space, mathematics, chemistry, early camera techniques, and medicine.



An interested visitor looks at two PHSCologrames at the Ames Visitor Center.

Against a very challenging and unforgiving schedule, TID had to develop a compelling, cost-effective display for the freestanding PSHCologram exhibit. "The TID solution was really quite clever," said Morse. "What's more, it required no alteration to our facility, and the cost was minimal."

The TID design solution was, literally, off the wall. A raceway of electrical outlets was installed on a metal track above the exhibit (to take advantage of the building's open ceiling design). Each box was suspended away from the wall and at different heights. The boxes were hung from the rafters using stainless steel aircraft cable...a material not in short supply at Ames.

Wire grids about 2" off the wall framed pairs of boxes and created a screen effect. Each pair of lightboxes was hooked to its appropriate screen using "S" hooks purchased at the store (at $.20 each). Finally, the boxes were plugged into the raceway via extension cords that were the same color as the wall.

Museums across the U.S. handling "Science in Depth" before Ames had spent up to $80,000 to install false walls and develop custom wiring schemes. The TID solution, which totaled *less* than $1,500, was roundly praised as superior to any previous format devised for "Science in Depth"—regardless of cost.

In fact, Ellen Sandor, Director of $(Art)^n$ Laboratory and the person who had made the PHSCologrames available to Ames, has since suggested that the same approach be adopted in subsequent

"Science in Depth" exhibits.

The very popular "Science in Depth" exhibit ran at the Ames Visitor Center from December 1991 through July 1992. "It was a spectacular presentation," said Morse. "I applaud TID for its work."



This photo of NASA aircraft at Dryden will appear on the cover of the* Journal of the American Aviation Historical Society *in the issue carrying Ms. Shafer's article.

Dryden Targets Professional Journals

For more than two decades, NASA researchers have turned to STI Program professionals for assistance when publishing in the NASA technical report series. But researchers have not always relied on STI Program expertise when publishing outside the NASA STI family of publications, such as in professional journals.

At Dryden, all that is changing. Now, when local researchers want to publish in journals, many begin by contacting the STI Program for assistance. This way, Dryden researchers are freed up to spend more time on their research while STI professionals handle the publishing details. At the same time, the STI Program promotes a wider range of services to its users and builds even stronger ties with those users in the process.

STI Program assistance in journal publishing arose from the need to get more mileage out of the valuable research done at Dryden. The STI Program professionals also wanted to encourage engineers who did not attend conferences to publish their work in a shorter format. The journal approach was the perfect arena.

The solution was a Dryden-developed "hit list" of aerospace publications. Dryden's senior editor contacted each publication for a current issue and inquired about the editorial window (what kind of articles the publication wanted), the format of choice for submissions (basic manuscript, mechanicals, or electronic), lead time for publication... and a wide range of related publishing concerns.

Armed with this information, the Dryden STI Program staff alerted local researchers: STI was eager to pilot articles to professional journals.

The first researcher to respond—others have followed—was Mary Shafer, a flying qualities engineer at Dryden and an Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA).

Shafer's first journal submission, mutually agreed upon with her Dryden editor, was originally a NASA TM, "Inflight Simulation Studies at the NASA Dryden Research Facility." Shafer had also presented a paper on the same subject at the recent AIAA Simulation Technology Conference in New Orleans.

The first journal thought they could use the article, but it would have to be trimmed by 40 percent! Shafer felt strongly that the article's integrity could not be compromised.

Her STI Program editor suggested a second possibility, *Journal of the American Aviation Historical Society*. The editor sent a computer disk containing the article in a flat ASCII file to the journal, as they had requested. Photographs were digitally scanned into the article, but the editor gathered up the originals and sent them along as backups.

The result? *Journal of the American Aviation Historical Society* swooped up the submission...so enthusiastically in fact that it plans to run a related Dryden photo on the cover of the issue containing Shafer's article. This provides outstanding visibility to the work of Shafer and NASA.

"The STI people did a wonderful job getting me references for this article, then sending it out for publication," said Shafer. "I'm so glad this has all worked out. I'm really proud of that piece."

Searching for SOHO at GSFC

The link between STI Program work today and NASA progress tomorrow is

not always clear. Recent literature searches at GSFC provide a compelling example of that connection.

In July 1995, the U.S. expects to launch the Solar and Heliospheric Observatory (SOHO), a spacecraft destined to make history.

SOHO is just one component of the International Solar-Terrestrial Physics (ISTP) program. ISTP is an effort to draw on the resources of the worldwide scientific community to study the Sun-Earth system—and then extrapolate this knowledge to the other planets and the universe beyond.

SOHO is a cooperative venture between NASA and the European Space Agency (ESA). SOHO's primary function will be to take remote measurements of the Sun and the solar wind with unprecedented accuracy.

To do so, SOHO will first have to be placed in an L_1 orbit, a "halo" orbit in which the Sun is in continuous view of the spacecraft. In an Earth orbit, by contrast, the Earth would periodically block SOHO's view of the Sun—and thus hinder the craft's data gathering ability.

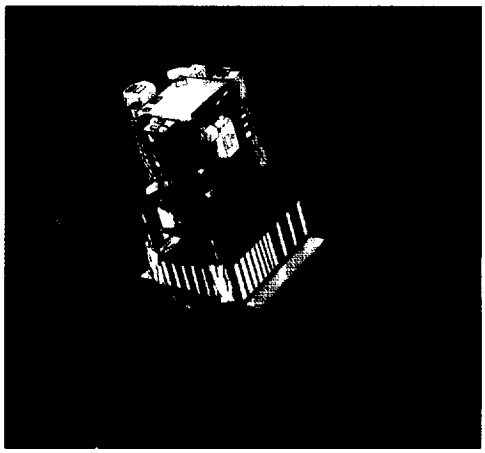
Engineers programming SOHO for the L_1 orbit have to consider many accelerations, including the gravity of the Earth (factoring in the Earth's "non-sphericity" or pear shape), the Sun, and the Moon.

Once in orbit, SOHO will experience a variety of accelerations because of solar radiation pressure and other factors. These variations produce small errors in the halo orbit...errors which will grow exponentially if neglected. To counteract this problem and keep the spacecraft on its predetermined path will require *periodic path readjustments*, or "station-keeping."

In short, the calculations needed to achieve and maintain the L_1 orbit represent an *enormous* mathematical challenge.

Steve Stalos, an engineer working for a major NASA contractor associated with the Goddard Space Flight Center (GSFC), confronts those challenges daily. Stalos is a member of the trajectory design team working under the Systems Engineering and Analysis Support (SEAS) contract. Most of his time is devoted to designing trajectories for SOHO and other spacecraft.

Various approaches are described in great detail in a number of ESA documents dating from the early 1980s. Unfortunately, many of these documents are poorly identified and, not surprisingly, hard to obtain. "The Goddard librarians have been incredibly helpful with these literature searches," says Stalos. "They located *every* document I requested, usually very fast."



SOHO will help us understand the interactions between the Sun and the Earth's environment.

"In a larger sense, the international side of this project is so important," he says. "These documents are most helpful in maintaining close cooperation between the U.S. and ESA."

"When I think about the future and my work," he says, "and what will happen when the librarians are given even more enabling technology...well, I think I'll be using the Goddard library, and benefiting from it, for a long time."

As for the SOHO project, the future is focused on July 1995. "When that Atlas blasts off with SOHO, then starts to arc and roll toward the Sun," he says, "that's the real payoff for me."

Indexing Capability No Longer Remote at JPL

The recent publication of *Microwave Remote Sensing of Sea Ice* was a watershed event for the Jet Propulsion Laboratory's External Publications Group, part of JPL's STI Program.

Funded by NASA and the Office of Naval Research, *Remote Sensing* offers 26 chapters that cover science's latest advances in the observation of ice with satellite-borne microwave instruments. No other book—worldwide—provides the same depth and breadth of coverage of this highly specialized field.

Dr. Frank Carsey of JPL's Oceanography Group served as editor in chief of this seminal reference work. Its 67 authors represent institutions from around the globe that are in the forefront of these unique sea ice investigations.

But while JPL's External Publications Group edited and produced the 475-page tome, the book was also fated as the forum to debut a talent no one, including External Publications, knew they had: index development.

The evolution of the book's chief text editor into an index builder sprang from necessity, the time-honored origin of so much inventive behavior. Near the end of the book's production process, to keep it on schedule, the editor volunteered to handle the index creation herself.

To provide this capability, the editor built a reference file on index creation procedures, researched other indexed books on the same topic, and found an indexing workshop offered nearby. Another piece of the index puzzle centered on the suspected flexibility of

the JPL publishing software.

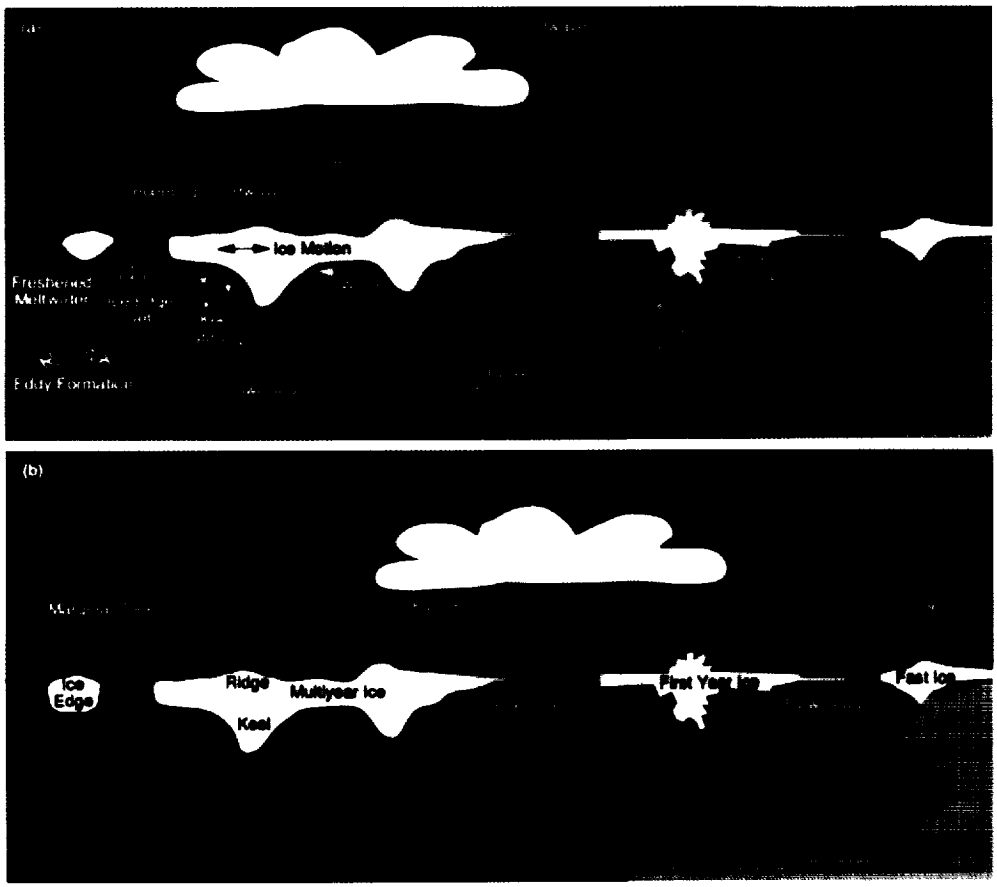
The editor's new task featured ongoing and frequent exchanges with Carsey on which items belonged in the book's burgeoning, cross-referenced index. But it was the JPL software's ability to allow terms to be designated in the text and then incorporated into the index that ensured the editor's efforts were both speedy and meticulous.

If few *Remote Sensing* readers were aware of the editor's publishing detour, readers and non-readers alike came to appreciate the results. Word of External Publication's indexing expertise spread rapidly. Even before the book was off the press, other Laboratory researchers had already asked JPL editors to handle index creation for their publications, too.

Remote Sensing was a particularly appropriate arena for introducing new publishing skills. The subject area it examines is similarly fraught with change brought on by new technologies.

Human activities in the polar regions have undergone incredible transformations in this century. Among them is the revolution satellites have introduced for those trying to gain information on polar geophysical processes.

"We're at a transition point in sea ice studies," says Carsey. "We're less concerned with ice itself and more about its role in climate systems. This change was the main reason for putting the book together."



This illustration from* Remote Sensing *shows processes that relate to ice cover and how we monitor sea ice from spacecraft.

As for the book's production process, "I have to thank the JPL editorial staff for their fine work," says Carsey, himself a nationally renowned expert in the remote sensing of sea ice. "Their very great skills and remarkably long hours helped make this book a great success."

Perspective and Perseverance Make the Difference at JSC

When STI Program resources are combined with the talents of a seasoned scientist-astronaut, the results can be formidable. Yet, sometimes success demands an additional quality...as in the case of Dr. William Edgar Thornton.

Prior to joining NASA, Thornton gained extensive experience in both aerospace and biomedical instrumentation, which ranged from work on missile scoring systems to developing the first mass measuring devices for use in space travel. He always found library research and documentation to be an integral part of the development and use of his equipment.

On joining NASA, he did many original studies on the effects of weightlessness and countermeasures as a Capcom and a Principal Investigator on Skylab. During these studies he developed many flight items, including the Shuttle treadmill, which he used during his flights on Challenger (STS-8 and STS-51B). He has earned numerous honors while at NASA, published extensively (as his many citations in the NASA STI Database attest), and secured more than 25 United States patents.

After developing exercise equipment and other countermeasures for extended duration Orbiter and Space Station, he became concerned with other effects humans may encounter during longer flights, some of which are now in the planning stage at NASA. His first step was to become better acquainted with "what's out there."

There are major differences between



Literature searches at the JSC library helped Dr. Thornton (shown here) develop the Shuttle treadmill, a device astronauts rely on to maintain fitness during space travel.



Two members of the Ice Team proceed with the ice/frost inspection prior to the STS-50 launch.

the Earth and Martian orbit environments—and even more differences to be experienced while traveling between them. Common to these "space environments" are low pressure and density. But they differ greatly in light, heat, radiation, magnetic fields, and gravitational forces...all of which affect human survival.

Recently, Thornton contacted STI Program professionals at Johnson Space Center to help him search the literature on the characteristics of various space environments. Unfortunately, the significant differences in space environments are not reflected in some of the current literature. "A number of the recent publications highlighted in the automated search still refer to a single space environment," he says.

To gain more detailed and accurate insights into space environments, he and his colleagues at the STI Program have turned to more traditional methods.

"Together, we've been searching shelves and contacting likely sources for the information I need—individually," he says. "The approach may not be high-tech, but it's producing valuable results...thanks in large part to the librarians' extraordinary efforts."

Thornton's research situation demonstrates the need to enter new research results into the STI system. Having all the current research available for reference can save time, and avoiding repetition of prior work can save great sums of money.

Does Thornton expect to go on the mission to Mars? "No," he says, chuckling. "I'll leave that to my grandchildren. Still, what we're working on today will be essential to the success of the Mars mission—and many others. But no matter what mission I'm on, I know that the NASA library system and especially the local JSC library will always be an essential resource for my work."

NASA TM Helps the KSC "Ice Team" Ensure Smooth Shuttle Operations

One largely unheralded group of NASA engineers, known affectionately as the Ice Team, epitomizes an agency truism: Those who work behind the scenes can be crucial to the success of those who make the headlines.

Similarly, little-known NASA Technical Memorandums (TMs) that detail each Shuttle launch have become a key resource for Ice Team members as they prepare for their launch day activities.

Garbed in bright orange jumpsuits, the Ice Team is among the few groups to arrive at the Shuttle pad on launch days, immediately following fueling operations. Outfitted with binoculars, cameras, infrared thermal imaging detectors, emergency breathing packs, and two-way radios, the team is well equipped to perform its duties with speed and precision.

"We like to head out to the pad confident that we know everything we can about the Shuttle, the weather, and what awaits us," says Greg Katnik, Flight Structures Engineer and Ice Team leader. The NASA TM produced after each Shuttle launch plays an important role in building the team's knowledge bank—and preparing team members for the next launch.

In 1988, Katnik came to STI Program professionals at Kennedy Space Center for guidance in producing a publication that would record and analyze Shuttle operations from his group's perspective. They suggested he publish a Technical Memorandum, a NASA publication of scientific and technical findings that don't require broad dissemination, and they gave him advice concerning formatting the piece (how to set up cover, text, and approval pages), positioning photos and captions, and preparing the final pages for the printer.

"They walked us through the whole

process," says Katnik. "Now I just bring in the formatted report. The STI people handle the printing, the collating, and bring me back a stack of reports for distribution. It's that simple."

Areas summarized in these NASA TMs created by the Ice Team include:

► **Ice**—A certain amount of ice always forms along some regions of the external tank's foam exterior and around the umbilicals which connect the tank to the Shuttle orbiter. One job of the aptly named team is to make sure the ice isn't excessive or a potential threat to the safety of the astronauts or the Shuttle.

► **Debris**—Team members inspect the vehicle's exterior for anomalies, such as loose or dinged tiles, which can result from debris on the launch pad, boosters, fuel tanks...anywhere. These anomalies can require repairs, which cost NASA time and money.

► **Thermal Protection System (TPS)**—A foam is applied to the Shuttle's external tank to minimize ice buildup. The team scrutinizes this foam for proper thickness and density. They also check the blader on the solid rocket boosters and tiles on the Orbiter.

► **Photographic Analysis**—Mission photography occurs on launch, on orbit (shots are taken by the astronauts), and during landing. The Team reviews every photo, video, and film for relevant performance data.

The Ice Team also incorporates trend analysis into each TM, shows where there were problems *and* how they were solved. Along with text, each TM includes charts, tables, graphs, and photos...whatever explains the problems, and the solutions, best.

"When we first starting producing the TMs, I got some calls about how professional they looked," says Katnik. "Today, my colleagues and I are still pleased with them—and I think lots of other people are, too."



The work of NASA researchers will play an important role in the development of hypersonic vehicles, such as the National Aero-Space Plane.

Langley Researchers Let Their Fingers Do the Walking

Thanks to a service recently offered by the NASA Langley Research Center's Technical Library, Center researchers can do more work in less time than ever before.

Since the first quarter of 1992, Langley researchers have been able to access the Technical Library's citations from their workstations using the Center's wide area computer network, LaRCnet. This service is available to all of the Center's 2,500 scientists and engineers.

Using LaRCnet, users can connect to the Scientific and Technical Information Library Automated System (STILAS), the integrated library system that provides access to listings of the library's entire book and journal collection, as well as to portions of the document holdings.

The advantages are obvious. Researchers no longer have to walk or drive to the library, or phone the librarians and ask them to do a search. Neither the sweltering heat of August nor the frosty winds of February affect a researcher's ability to access the library's extensive holdings. Year-round, it's nearly as simple as logging onto your computer.

STILAS is only the latest library search tool available to Langley researchers on LaRCnet. Since the mid-1980s, Langley researchers have had desktop access to the NASA STI Database via RECON, the STI Program's original information retrieval system.

Cathy McGinley, an aerospace engineer in Langley's Experimental Flow Physics Branch, is a strong advocate of telecommuting to the Center's Technical Library.

"I'm a heavy user of the library's online systems," says McGinley. "I usually make searches on RECON or STILAS every other week, and it's great not to have to trudge over to the library to do them."

McGinley says she also likes the control this new system gives her. "The librarians can certainly be very helpful," she says. "But I prefer to search for documents on my own, right here at my desk. That way, I have immediate access to the citations. In a time-sensitive environment, that's important."

Speedy literature searches are especially appropriate for researchers like McGinley who are committed to the development of aircraft that travel at hypersonic speeds (more than 3,000 miles per hour).

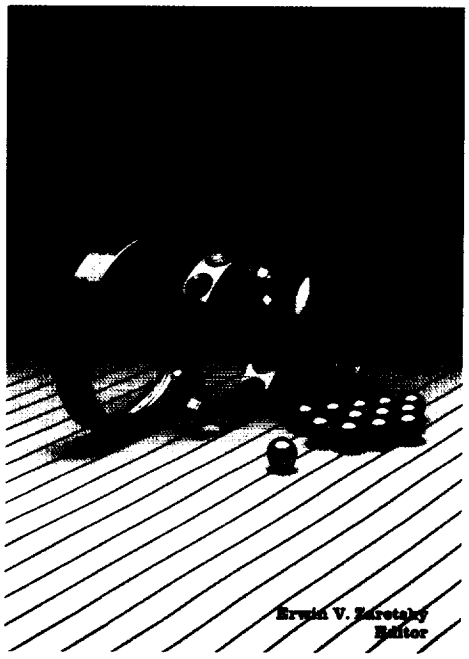
McGinley, who has completed the first two years of her Ph.D. in Aerospace Engineering, says her most recent search was on a turbulence boundary layer investigation.

"When you're working in hypersonic research," she says, "information from literature searches goes a long way in helping you design better experiments. The results of these experiments will eventually produce turbulence models, which will be used to design the hypersonic vehicles of the future."

"The library is always looking for new ways to serve us better," McGinley concludes. "Connecting STILAS to LaRCnet is just one example. Once you're in STILAS, you can see which items the library has, and which are checked out. If you need an item right away, you simply pick up the phone and talk to the person who has it. And, once again, you've never left your work area."

New Lewis Publication Helps NASA Gear Up for the Future

In the years ahead, engineers worldwide will be able to turn to a 1992 publication from the Lewis Research Center—*STLE Life Factors for Rolling Bearings*—for unrivaled insights into the design of rotating machinery. Several members of Lewis's Technical Information Services Division (TISD) can be proud that they helped to make this prestigious publication a reality.



The unique cover of* STLE Life Factors *was a collaborative effort of the TISD design staff and an engineer colleague of Mr. Zaretsky's.

Edited by Erwin V. Zaretsky, Chief Engineer for Structures at Lewis, *STLE Life Factors* will likely influence a broad range of work at NASA and the aerospace industry, including research and design of aircraft engines, turbopumps for rocket engines, and gearboxes for turboprop aircraft and helicopters.

STLE Life Factors represents the accumulated knowledge of 18 of the nation's leading mechanical engineers or, more specifically, tribologists. (Tribology deals with the design, friction, wear, and lubrication of interacting surfaces in, for instance, bearings or gears.)

For decades, Lewis has been NASA's lead agency in research on aircraft and spacecraft propulsion systems and, as such, has developed an international reputation for its research on rolling-element bearings and lubrication.

In fact, work done by Zaretsky and his colleagues has helped shape dramatic improvements in bearing life. Using 1940 as the baseline technology, bearing life was five times greater by 1957, 13 times by 1970, 100 times by 1976, and *200* times greater by 1985! *STLE Life Factors* documents these momentous developments.

This 318-page volume is an updated and expanded version of a 34-page monograph on the same subject edited by Zaretsky in 1971. Lewis's TISD staff assisted Zaretsky in this earlier effort—also a pioneering publication in its day—as well as with scores of technical papers he has authored throughout his distinguished career.

In 1985, the Society of Tribologists and Lubrication Engineers (STLE) asked Zaretsky to organize a committee of experts to update and enlarge the 1971 monograph. The committee—composed of a cross section of leading engineers from industry, private research labs, government labs, and academia—structured, wrote, and reviewed the new volume.

After Zaretsky edited the basic manuscript, he passed it on to the TISD staff. TISD copyedited the text, then developed the book's design, which includes original artwork and more than 100 illustrations.

"The TISD people made life much easier for me," he says, "particularly the copyeditor, who already had a keen subject knowledge of this field from years of editing my work. This cooperative effort reflects NASA's commitment to technical excellence. *STLE Life Factors* can be considered a definitive and comprehensive overview of NASA's contribution to rolling-element bearing technology."

Re-evaluation of Launch Systems Launched at MSFC

In recent years, we've heard much about the need for NASA to upgrade its launch vehicles. In response to that need, Chris Barret, a member of Marshall Space Flight Center's Vehicle Control Systems Branch, has begun a two-year study of launch systems. Her findings could have far-reaching consequences for a broad range of future NASA missions.

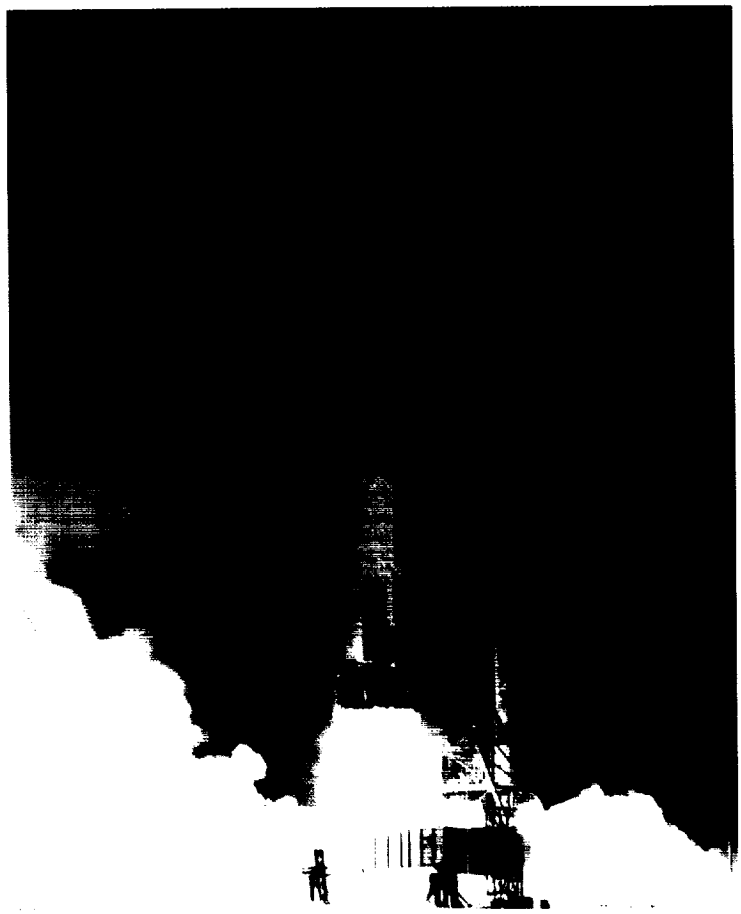
The challenge, stated simply: NASA needs new launch vehicles that do more and cost less. To help meet that challenge, Barret is identifying and re-evaluating design concepts seen in selected NASA launch vehicles of the past.

"Now, in this project's early stages, I'm relying heavily on assistance from local STI experts," said Barret, already a frequent user of Library and Technical Publications personnel at MSFC. "They're helping me access hundreds of NASA technical reports and related literature, which contain countless critical design details."

Barret has been awarded a Center Director's Discretionary Fund Research Award and has begun her research by reviewing the aerodynamic flight controls of such historically important NASA launch vehicles as the Redstone, Jupiter C, Saturn I, and Saturn IB.

She'll also look carefully at the flight control concepts embodied in the Saturn V, the vehicle she thinks may hold the greatest promise in helping her and others design new launch vehicles.

Barret is currently a Ph.D. candidate from the University of Tennessee Space Institute in Aerospace Engineering. Her tentative dissertation topic—Launch Vehicle Flight Stability and Control—will involve the analysis of rigid body, elastic body, and sloshing propellant effect in launch vehicles. Many of her findings will prove most useful in her MSFC research.



The Saturn V—in its day, one of NASA's leading launch vehicles—is shown here in July 1969 as Apollo 11 begins its historic journey to the Moon.

The purview of her Marshall research will not be limited to the many proven U.S. launch systems. She'll also review aerodynamic flight control surfaces currently used in French, Russian, Chinese, and Japanese launch vehicles.

Further, Barret will assess the state of the art in lightweight composite materials for aerodynamic flight control surfaces. These include fins (a fixed or adjustable airfoil or vane attached longitudinally to the launch vehicle), canards (small wings on the vehicle's nose), and moveable strakes (webbed surfaces along the fuselage). She might even design completely new flight control surfaces. "Certain designs of the past reconfigured in new materials might be the best way to go," she said.

Armed with her wealth of new information, Barret will move on to design flight control systems. Then she'll have wind tunnel models fabricated and oversee a battery of wind tunnel tests to be conducted, appropriately, at Marshall—long known as a leader in the development of NASA launch vehicles.

The new technologies and launch systems Barret uncovers could light the way for upcoming NASA missions of historic importance—and save this agency enormous costs at the same time. Asked to name missions her work might affect, her reply is concise yet comprehensive: "Any NASA missions that need a launch vehicle, be they trips to Space Station Freedom, the Moon, Mars...or beyond."

Stennis Team Assesses Hurricane Damage and Helps Ease the Pain of Thousands

Since its founding, NASA has scored numerous victories in its attempts to unravel aerospace mysteries. But some-

times the agency faces mysteries back on Earth that are just as perplexing as any lurking about the heavens.

In August 1992, when Hurricane Andrew struck the tip of southern Florida then moved into Louisiana, the destructive power of the killer storm seemed almost incomprehensible. Thanks to remote sensing professionals from the Science and Technology Laboratory at Stennis Space Center (SSC), the resulting devastation was brought into focus—and hurricane cleanup efforts were given a major assist. (At SSC, the Science and Technology Laboratory is part of the STI Program.)

A phone call from Florida Governor Lawton Chiles to Vice President Dan Quayle on August 27 set the process in motion. The next day, one of the SSC remote sensing teams was on the Stennis Lear 23. The plane had been rigged for data acquisitions and was bound for Ft. Lauderdale. Their mission? Lend their expertise to the Governor's Hurricane Andrew Disaster Assessment Team.

On August 29, the Stennis specialists were at work, acquiring both multispectral digital data and aerial photos of southern Miami and the Homestead area.

The data were critical to an accurate assessment of Andrew's impact, which then helped officials determine how best to allocate human and financial resources needed in the cleanup.

Data gathering sessions continued until September 4, with the team's flights punctuated by meetings with the Governor's staff to review findings and plan the next assignment. Use of the data acquired over Florida was also coordinated with representatives of the Federal Emergency Management Agency (FEMA) and the U.S. Corps of Engineers.

The remote sensing data later became a crucial part of briefings on hurricane damage to the Florida legislature and the U.S. Congress. With the support of the images, the governor was able to secure adequate disaster relief funding for his state.



This is just one of the many remote sensing images taken by the Stennis team following Hurricane Andrew. The team's work played an important role in damage assessment and subsequent cleanup efforts.

Originally, the SSC team was slated to provide additional remote sensing coverage of Everglades National Park, again to assess the level and nature of Andrew's destruction. But continuing harsh weather made those flights impossible. (Flights over the Park were finally made several weeks later.)

In short, by simply plying their trade, members of the SSC remote sensing team proved an enormous benefit to hundreds of thousands of newly homeless Floridians trying to pick up the pieces of their shattered lives.

In a letter written by Governor Lawton Chiles to Vice President Dan Quayle some days later, the Governor said, "I certainly appreciate your prompt attention to my August 27 request to have a high resolution photographic survey conducted of South Florida soon after Hurricane Andrew desolated the area. The survey contributed significantly to our efforts to obtain an accurate assessment of the extensive damage the storm inflicted upon this vast area." •

Support Operations

Domestically, the Program's two primary support operations are:

- **The Center for AeroSpace Information** (CASI); and
- **The Technical Information Service** (TIS).

The TIS follows a process for input processing its new STI similar to that described previously for the CASI in "The R&D Information Cycle." Every two weeks, information from the TIS is electronically transferred to the CASI.

At each of these locations, thousands of records are added into the NASA STI Database each month. The CASI focuses on acquiring technical reports, adding more than 37,000 to the Database annually. TIS emphasizes published literature, such as journal articles, books and conference proceedings. It adds more than 47,000 items each year.

NASA Centers

The NASA STI Program maintains operations at NASA Centers throughout the United States. NASA researchers at these facilities generate much of the Program's scientific and technical information.

Following is a brief description of recent STI accomplishments at each Center.

NASA Headquarters Scientific and Technical Library

Joseph A. Langdon
Head, S&T Library & Systems Support
Washington, DC

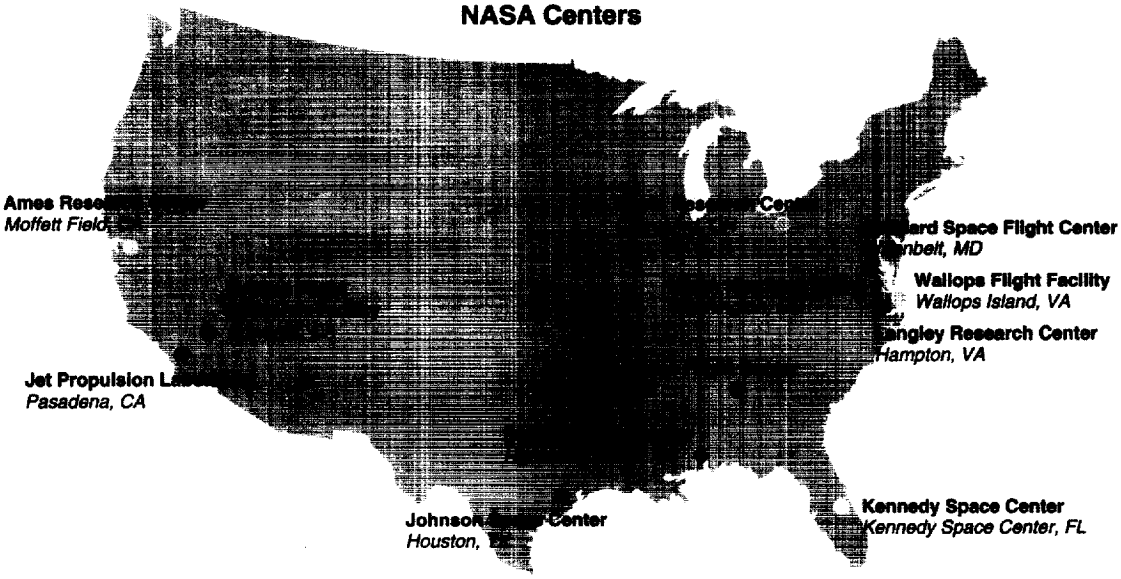
The NASA Headquarters Library provides scientific, technical, and management staff with rapid access to information on a cross-section of topics. Accomplishments for fiscal year 1992 include:

- **Library Relocated to New Quarters**—As part of the NASA Headquarters consolidation, the Headquarters Library was moved. Now located just off the lobby of the new Headquarters building, the library offers NASA executives easy access to its extensive holdings.

Some 14,000 books and journal titles and 1.5 million pieces of microfiche were moved within a period of one week. Special features of the new library include an airy reading room, space-saving moveable stacks, an audiovisual room, separate reference and circulation areas, and additional work space for researchers and library staff.

The integrated, easy-to-use collection has special sections including the Program and Project Management Collection, Quality/Product Awareness Collection, NACA documents, selected NASA documents including NASA Special Publications, and the Congressional Record.

- **Scientific and Technical Collections Upgraded**—More than 250 titles in key areas of science and engineering were added in FY 92.
- **Information Requests Addressed**—Online searching supports the research needs of NASA employees and contractors. Some 792 searches were performed in the NASA STI Database, in commercial databases, and on CD-ROM products. In addition, the library responded to 2,448 reference requests from



NASA staff, contractors, businesses, and the public; circulated 6,937 items; and ordered 837 NASA documents for staff and contractors.

Plus, the library assisted NASA Headquarters offices in evaluating full-text and imaging systems for information retrieval.

► **Library Committee Provided Input**—While representing the needs of Headquarters offices to the library, the Library Committee reviewed recommended titles, assisted in the writing of a Headquarters Library Collection Development Policy, and provided ideas on the new library design.

► **Space Station Support Expanded**—The library's Space Station Freedom location has also moved to new, larger quarters. The move reflects growth in library materials and services. Space Station library offers an expanding collection of CD-ROM products covering specifications and standards, computer literature, and reference material.

During fiscal year 1992, the Space Station library responded to 609 reference requests from employees and contractors based in Reston, VA, performed 323 online searches, and ordered 848 NASA documents.

Ames Research Center

Paul Bennett
Chief, Technical Information Division
Moffett Field, CA

The Technical Information Division (TID) is STI at Ames Research Center, Moffett Field, CA. TID prepares nearly 200 publications and 2,500 illustrations each year in support of some 700 researchers.

Accomplishments for fiscal year 1992 include:

► **Integrating Total Quality Management (TQM)** into its culture (see page 46).

► **Stressing computer compatibility with customers**. To best serve Ames researchers, TID has continued to keep abreast of current computer technology. Documents come into TID as products of a variety of computer applications. Management ensures that the staff has adequate time to work, train, and expand its knowledge of current technology. Software throughout TID itself is standardized to maintain TID's quality output and archiving.

► **Helping researchers access the library.** Ames Library staff developed remote access software (LibSearch) to allow on-site Macintosh users access to the Library's book catalog from their offices. Patrons can access large databases of information ranging from bibliographies to, eventually, complete text of NASA technical reports. The Information Sciences Library, opened this year, supports research in artificial intelligence, neural networks, intelligent mechanisms, optical processing, robotics, and data management systems for control of the Space Station.

Acquisition requests are now tracked and documented online for accounting purposes in an easy and uniform way. This speeds access to information on the status of book orders and increases the Library's ability to provide timely responses to patrons.

► **Illustrating the space program through graphic art**. The Graphics and Exhibits Branch offers its craft to the various offices at Ames and shares NASA accomplishments with the public through displays at the Smithsonian (20th Anniversary of Pioneer 10) and the Ames Visitor Center ("Science in Depth," see pages 13-14).

► **Increasing reproduction services with less money and fewer people**. Output increased dramatically in the Reproduction Services Branch. Quick Copy produced 900,000 copies per month (up from 740,000 in '91), and it printed up to 535,000 copies per month (up from 420,000 in '91).

Reproduction Services installed a color copier which is connected via a server to Graphics and Publications. This allows Graphics and Publications to output proofs and production work directly to the color copier and cuts production costs because color proofing does not have to be sent to a vendor. Another new machine, an engineer drawing copier, can copy drawings as large as 3 feet wide by 10 feet long.

Dryden Flight Research Facility

Gregory A. Shell
Chief, Reports and Presentation Branch
Edwards, CA

The STI Program underwent major changes at Dryden in 1992. The stage for these developments was set early in fiscal year 1991, when Program management moved to Dryden's Reports and Presentation Branch. Last year saw the consolidation of the Program's functions as different elements of the STI Program moved to Dryden management.

Accomplishments for fiscal year 1992 include:

► **Dryden Library was established as separate ARIN site.** The Library's acquisition, cataloging, and circulation functions were moved to a separate processing unit within ARIN, to allow Dryden to establish its own library policies. The Library also became a fully functioning member of OCLC. Current efforts focus on the automation of Library functions including management functions and increasing use of electronic databases and CD-ROM products. The Library, which operates in both the DOS and Macintosh environments, was added to the Dryden network.

► **Dryden-authored STI documents increased 27 percent over FY**

91 levels during the past year, with conference papers and conference proceedings showing the most growth. These products continue to be published through the STEPS (Scientific and Technical Electronic Publishing System) started in 1990. STEPS allows text and graphics to be produced by the authors at their workstations, then entered into the electronic publishing system for editing, design, and production. About 98 percent of Dryden's STI documents, including presentations, are produced electronically.

Dryden contributions to STI literature included 42 Technical Memorandums, 10 Contractor Reports, 39 Conference Papers, 11 Conference Proceedings, and 1 journal article.

► **Dryden's Electronic Presentations System (EPS) is used for hard-deadline, high-quality presentations.** Users can create, produce, and show presentations electronically. A presentation can be created at the user's workstation or by submitting it to the Reports and Presentations Branch. User-prepared presentations utilize guidelines and templates prepared by the branch, thus ensuring compliance to Ames, Dryden, and agency standards.

► **Dryden is moving into multimedia/interactive presentations.** The branch is working with other facility assets in preparing the facility's first multimedia presentation, involving computer animation combined with live-action video. This presentation (for the facility's new Integrated Test Facility) has moved the branch into a new presentations arena. Future plans call for increased training and development of interactive multimedia presentations for educational, research demonstrations, and related uses.

► **Dryden hosted a High-Angle-of-Attack Symposium** featuring research conducted using several aircraft as test beds. Featured aircraft were the X-29, the X-31, the F/A-18, and the F-18 High Alpha Research Vehicle (HARV). During the three-day event, the Dryden facility hosted nearly 300 participants and produced a four-volume collection of high-angle-of-attack research papers (CP-3137).



The F-18 HARV was one of three flight programs mentioned in the Dryden conference proceedings.

Goddard Space Flight Center

Michael V. Woywod
Chief, Information Management Division
Greenbelt, MD and Wallops Island, VA

At Goddard Space Flight Center (GSFC), the Information Management Division coordinates STI Program activities through two branches, Library Services and Technical Information Services, which have elements at both the Greenbelt, MD, and Wallops Island, VA, sites. STI-related functions include library services, publication support (writing, editing, graphics), presentation graphics support, technical photography, printing and duplicating services, and conference support.

In fiscal year 1992, more than 1,000 STI documents were produced by the Center, including some 100 NASA reports, 400 journal articles, and 650 technical presentations. Other accomplishments include:

Library Services

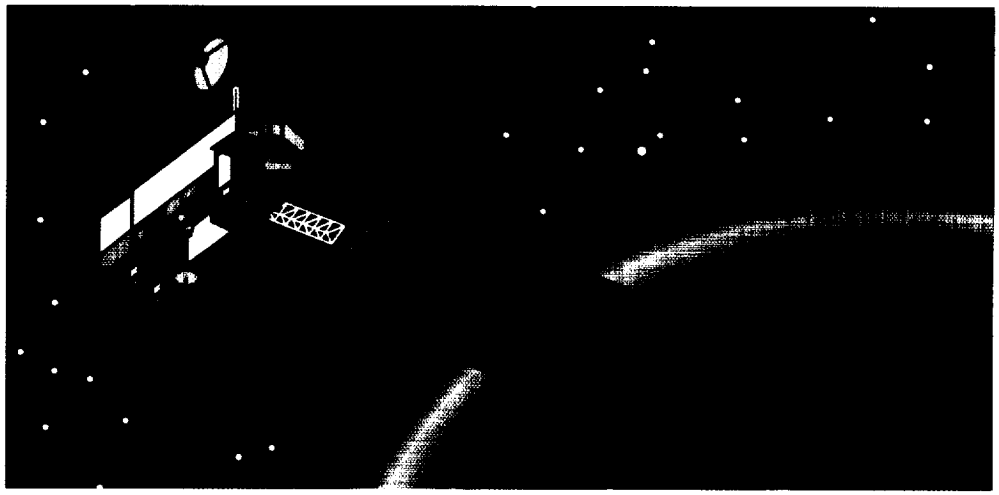
► **Acquired IEEE/IEE Publications Ondisc system**, which provides access to digitized images of entire issues of engineering and computing journals, conference proceedings, and standards publications.

► **Hosted the "Electronic Library Expo" week**. Demonstrations were

given on several of the library's electronic databases. The Expo culminated with a colloquium delivered by Helmut Abt, editor of the *Astrophysical Journal.*

► **Continued Customer Focus Program**, welcoming new members to the Library Council. The Council serves as liaison between constituent organizations and the Library Branch.

► **Participated in the STELAR** (STudy of Electronic Literature for Astronomical Research) **R&D Working Group** by evaluating the prototype online interface developed by the National Space Science Data Center (NSSDC). Funded by Code SMI at NASA Headquarters, the STELAR Project is bringing online digital images of the last five years of three major astronomical journals.



Nearly 35 percent of the computer graphics produced at the Goddard CGF, such as this colorful illustration, support the Earth Observing System (EOS) Project—NASA's centerpiece of "Mission to Planet Earth."

Technical Information Services

► **Formed a Publications Committee** made up of printers, editors, and visual information specialists, as well as the Center's Printing Officer and Graphics Coordinator, to provide efficient end-to-end support to the Center's technical community. Customers are often involved in meetings, ensuring that concerns are aired early—before problems arise.

► **Upgraded the Computer Graphics Facility** (CGF) with the addition of four new pieces of state-of-the-art hardware. CGF production has climbed steadily to last year's record breaking total of more than 9,000 pieces produced for over 1,000 customers.

► **At Wallops, provided graphics support** to the Puerto Rico Sounding Rocket campaign while supplying consistent, high-quality printing and graphics support to the suborbital sounding rocket and scientific balloon activities.



To illustrate the processing of planetary images, one portion of JPL's display at the World Space Congress focused on images from the Magellan Mission to Venus.

Jet Propulsion Laboratory

Charles B. Chapman, III
Manager, Documentation
and Material Division
Pasadena, CA

At the Jet Propulsion Laboratory (JPL), operated for NASA by the California Institute of Technology, the Documentation and Material Division implements the NASA STI Program through a range of support activities, including library services, supply and equipment, air operations and documentation, photography, and printing services.

Recent accomplishments include:

► **Taught technical writing classes.** The Documentation Section developed and implemented two new classes for JPL professional development.

Technical Writing teaches engineers, scientists, and managers how to research, organize, write, and revise reports. *Engineering Documentation* focuses on engineering formats, specifications, and writing tools.

► **Presented graphics display on image processing.** A four-color, 30- by 40-inch display explaining how planetary images are processed was created in the Graphics In-House Services Group for the JPL exhibit at the World Space Congress in Washington, D.C. The display covers processing from telemetry to image strips to mosaics and even to three-dimensional views or video "movies."

► **Formed six committees** of JPL library staff personnel to study and recommend improvements in cross-training, library space planning, marketing, serials weeding, document delivery services, and serials check-in, routing and tracking systems. Each committee meets on a regular basis and provides progress reports at the weekly library staff meeting.

► **Conducted customer survey.** The Duplicating Services Group of the Photographic, Printing, and Duplicating Services Section sent a customer satisfaction/concerns survey to 1,600 of its clients. Nearly 700 responses were received, with customer satisfaction averaging in the upper 90th percentile. A notice was published laboratory-wide to identify optimal hours of operation for satellite duplicating sites.

► **Inaugurated Electronic Publishing.** In mid-1991, an Electronic Publishing System Implementation Team was formed with Division 64. A thorough study of the two systems available from industry—Kodak "Lionheart" and Xerox "Docutech"—was completed in June 1992. The Xerox "Docutech" was selected as the system that best meets JPL's printing requirements. These requirements reflect future JPL publishing needs that follow the downgrading of the JPL printing facility to a duplicating facility, which was effective December 31, 1992.

Johnson Space Center

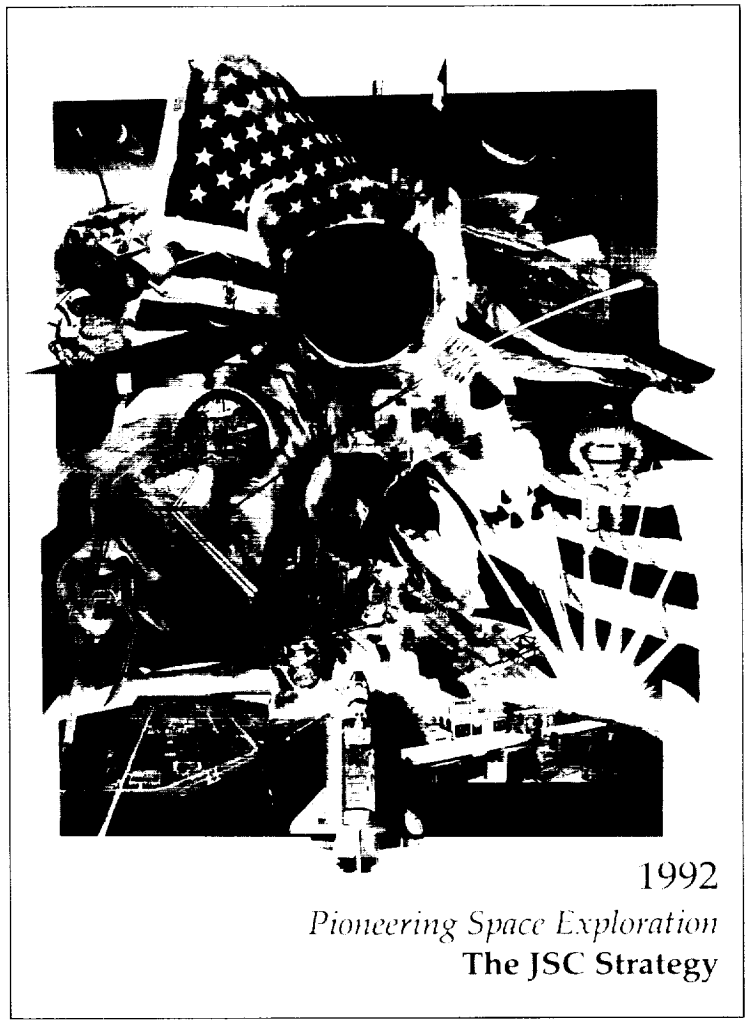
Carol Homan
Deputy Chief, Management Services Division
Houston, TX

The STI Program at the Lyndon B. Johnson Space Center (JSC) continues to raise local and agency-wide interest in Program information services and related capabilities. Recent accomplishments include:

► **Hosted the 1992 STI Program Annual Conference**. Held from April 28-May 1, 1992, the event offered opportunities for attendees to share information on new technologies in graphics, printing, publications and library science. More than 100 NASA STI Program professionals from across the agency attended the conference, whose theme—"A New Information Era"—summed up the week's memorable proceedings.

► **Provided publications expertise during the production of several special Center documents**, among them *The Space Educator's Handbook*, a first-of-its-kind JSC publication. Created in Hypercard on a Macintosh system, the *Handbook* is a compilation of historical milestones, statistical data, colorful anecdotes, and teaching exercises associated with the U.S. Space Program. Available on disk from JSC's New Initiatives office, this "soft-copy document" is expected to become a valuable education resource for students and teachers throughout the nation.

► **Assisted in producing the Center's long-range plan**. After JSC senior management finished drafting



***JSC's major, long-term goals and strategies are outlined in* Pioneering Space Exploration.**

their goals, objectives, and vision as embodied in the Center's long-range plan, STI Program Branch staff lent assistance in writing, editing, and designing a document that communicated these new goals and strategies to Center employees and stakeholders.

Every member of the senior staff signed the resulting document which, according to one senior staffer, "integrates the technical and programmatic inputs of a large and diverse committee into a coherent set of goals and objectives and clearly communicates the future vision and mission of JSC."

► **Greatly expanded STI Center capabilities through the implementation of LAN-based applications.** The CD-ROM network was expanded to provide Center-wide access to such databases as NTIS, Computer Select, and INSPEC by the end of 1992. The STI Center's Management Information System (MIS), which is also LAN-based, now includes modules for acquisitions and document delivery. By the end of 1992, this system included reference and overall work control functions.

Automation of the acquisitions and document delivery functions has thus far improved processing time by *more than* 100 percent in some areas while reducing labor resource requirements. The MIS was developed in-house by STI Center staff using existing computer resources.

Kennedy Space Center

Lex O. Pierce
Chief, Supply, Transportation, and Services Division
Kennedy Space Center, FL

At the Kennedy Space Center (KSC), STI Program activities focus on the Technical Library and its information services. Activities of most Program users are related to the Center's primary mission—launching the Space Shuttle.

Recent accomplishments include:

► **Completely renovated the Library's Reading Room and Specifications and Standards Department.** Compact, moveable shelving was added, new carpeting was installed, and walls and ceilings were repainted. Plus, space in the Library's Reading Room has been expanded to accommodate several new terminals for RECON, the patron catalog, and CD-ROM searching.

► **Established special collection of Total Quality Management (TQM) books and articles**. The Library maintains, prints, and distributes a current list of TQM titles to Center organizations. The collection is prominently displayed in the library for visibility and ease of use. All catalog entries are identified; special database searches are conducted upon request. This popular new collection recently grew to more than 700 entries.

► **Created special metric system collection** to support the mandated NASA transition to the metric system.

► **Broadened services to researchers by joining the Florida Information Network**. Membership provides free interlibrary loan to participants in this statewide network of libraries. The Library's new membership was a logical outgrowth of its existing participation in the Central Florida Library Consortium.

► **Converted to a new serials management system**. This move streamlines Library operations since more than 3,000 serials titles are routed at KSC annually.

► **Upgraded graphics capabilities**. The NASA/KSC Graphics Automation System has been hooked up to a new color copier. System modifications have made it possible for artwork to be printed directly from the computer network. Initially, this enhancement offers more convenience to users by supporting printing—complete, ready for pick-up—of the Center's color Group Achievement/Flight Awareness Award certificates and the processing of presentation materials (including charts, graphs, and viewgraphs).



Renovations at the KSC Technical Library are translating into improved service to users.

Langley Research Center

Andrew J. Hansbrough
Chief, Research Information
and Applications Division
Hampton, VA

During fiscal year 1992, NASA Langley Research Center contributions to STI literature included 339 NASA technical reports, 280 journal articles, 1,013 meeting presentations, 41 technical briefs, 42 patents, and 14 conferences or workshops sponsored or co-sponsored by Langley.

Recent accomplishments include:

► **Video Section of the Visual Imaging Branch produced more than 150 original videos in fiscal year 1992.** Several of these videos are being used as supplements to Langley-authored technical reports. Under the auspices of the Chief Scientist, future consideration is being given to preparing an "electronic" technical report.

► **Technical Editing Branch provided considerable support (editing and design) in the production of the Center's 75th Anniversary Book, *Winds of Change*.**

► **Photographics Section of the Visual Imaging Branch acquired high-resolution, high-speed video cameras** to support the Center's wind shear research/flight experiments.

► **Graphics Section of Printing and Graphics Branch produced the *Aircraft Rescue Handbook*.** The Graphics Section devised strategies for reducing labor and materials costs on this short run, labor-intensive color publication. The Section also developed an inexpensive method of producing vinyl letters for large display elements and one-of-a-kind signs.

► **Publications Section printed 265 classified or controlled jobs totaling 31,261 pages and 5,783,143 units.** This Section of the Langley Printing and Graphics Branch prints and distributes NASA technical reports for the entire agency. Certain of these reports are classified or controlled.



Two Langley photographers prepare for an aerial shoot.

Lewis Research Center

Richard E. Texler
Chief, Technical Information
Services Division
Cleveland, OH

Lewis Research Center's Technical Information Services Division (TISD) implements the STI Program through the following branches: Graphics and Exhibits, Photographic and Printing, Editorial, and Library.

1992 was another record year in numbers of publications, Lewis-hosted conferences, and other STI-related activities. Total production at TISD included 728 technical reports and 105 brochures. Usage of the online library literature request card, developed in April 1991, increased by 26.6 percent. A total of 3,215 electronic requests were made.

Although budget cuts have severely affected TISD, the innovation and creativity of the staff has resulted in the following accomplishments:

► **Lewis branch chief represented NASA on the Technical Information Panel** of the Advisory Group for Aerospace Research and Development (AGARD) in Lisbon, Portugal.

► **Lewis Document Repository was established** to serve as an intercenter/interagency location for reference documents pertaining to government specifications, standards and guidelines used in developing shuttle and Expendable Launch Vehicle (ELV) payloads.

► **Lewis Library provided foreign language services** to Lewis staff. These

services facilitated the completion of several projects.

► **The Lewis Library Outreach Program was presented to 45 research and development branches.** Each program was customized to reflect the informational needs of the individual research area, and to explain library services.

► **Lewis Library User Committee, composed of representatives from the directorates, was very active.** The Committee held 10 meetings, developed their charter, and presented 2 proposals for improving library services.

► **Lewis Publication Policy Review was conducted by the Editorial Branch;** a preliminary report was submitted to the Administrative and Computer Services Directorate Office.

► **Lewis Image Browsing and Retrieval Archive (LIBRA) Project was initiated.** LIBRA is a joint effort involving the Computer Services Division and TISD. It will initially supply an information retrieval system for scanning, archiving, browsing, retrieving, and printing photographic quality images in a networked environment.

► **A Traveling Art Show was developed** as a combined effort between the External Programs Directorate and TISD. The show will educate the local community and promote an awareness of the opportunities in the institutional areas of Lewis by means of a visual display of science and engineering.

► **Services to users were improved**, by downloading the results of literature searches to requestors' electronic mail accounts, resulting in decreased response time and elimination of paper copies.

► **Templates for various society formats were made available to Lewis researchers** who prepare their own documents for publication.

Marshall Space Flight Center

Annette K. Tingle
Chief, Technical Information
and Services Branch
Huntsville, AL

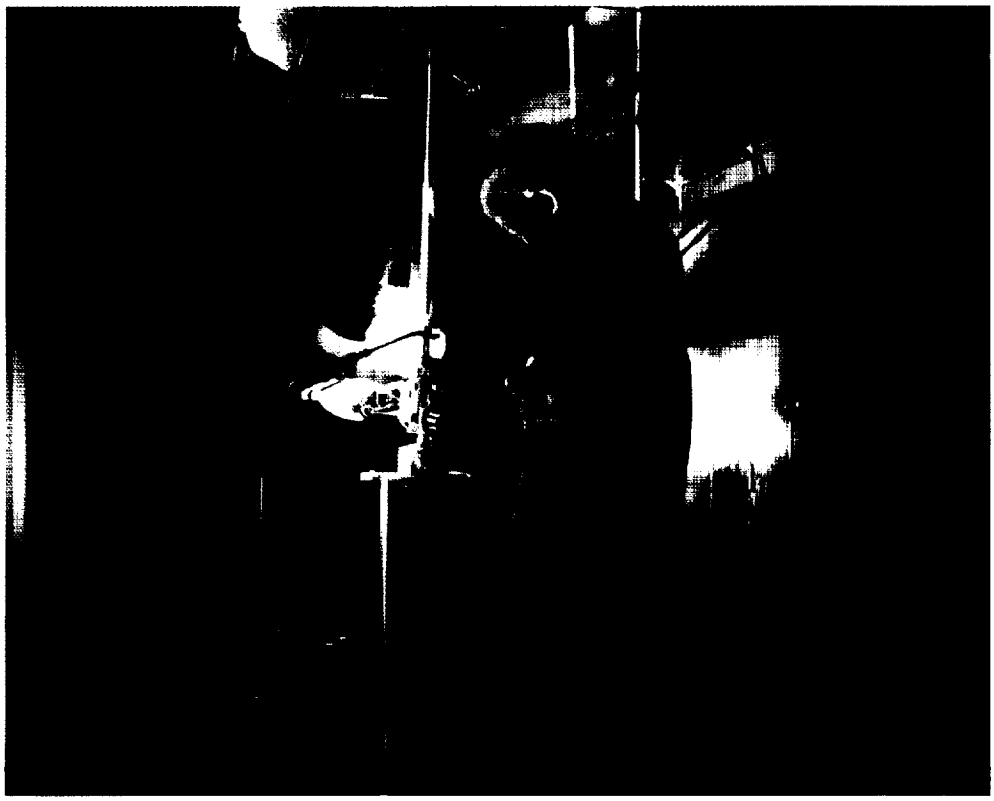
At the Marshall Space Flight Center (MSFC), the STI Program is coordinated through the Technical Information and Services Branch of the Management Operations Office. The MSFC Technical Library, Technical Publications, and Documentation Repository are part of the branch.

The MSFC Library works in coordination with the local Redstone Scientific Information Center (RSIC), operated by the U.S. Army Missile Command under joint Army-NASA sponsorship.

Recent accomplishments include:

► **The MSFC staff interviewed 116 engineers and scientists during phase two of the STI Council user survey**, in support of a NASA STI Program request. These interviews (45 percent more than the minimum sample requirement) offered new insights into user needs and afforded an opportunity to further publicize STI products. One result: interest in and requests for *SCAN* increased more than 30 percent.

► **The MSFC library upgraded its speed of access to databases** with the addition of two new 486 PC terminals. It also acquired the capability for future online document image retrieval from the



This photo of technicians de-icing a rotor is just one example of the imaging support TISD's Photographic and Printing Branch provided in 1992 for the OH-58 Tail Rotor Ice Impact Program at Lewis.

MSFC Documentation Repository.

RSIC enhanced its services to include implementation of a copying service giving rush or one-day service to patrons on photocopying of library materials. RSIC also has the ability to search foreign databases and provide translations in-house or through the NASA STI Program or other contractual services.

► **In fiscal year 1992, the MSFC Technical Publications area submitted almost 1,000 documents to the CASI**, including 78 NASA technical reports and 175 contractor reports.

The popular *STS Glossary and Acronym Listing*, last published in 1985 as NASA Reference Publication 1059, was updated and prepared in hard copy and disk format for local automation use. The online version is used in the Shuttle Projects Office and has the capability for use as a Center-wide public application.

► **The MSFC Documentation Repository made substantial progress** with enhancements to its UNIX-based Repository Automated Optical Imaging System (RAOIS). The VAX online index, which is available Center-wide, indicates the format (paper, microform, or optical disk) of the Repository's more than 15 million engineering drawings and other technical documents.

The Repository can now receive drawings and documentation electronically from MSFC internal and external sources. Retrospective scanning and optical disk storage has been completed for a considerable number of drawings and documents, including MSFC specifications, Shuttle configuration data, and propulsion systems data. These images can now be retrieved for viewing and use by the engineers at their own workstations.

Stennis Space Center

Robert R. Jeffries
STI Manager, SSC
Hancock County, MS

At Stennis Space Center, the STI Program encompasses the Technical Library, the Science and Technology Laboratory (STL), and the Technology Transfer Center.

In fiscal year 1992, Stennis Space Center's output of STI materials included 20 journal articles, 25 public conference proceedings papers, 8 Technical Memorandums, and 7 chapters for scientific and technical books.

Other recent STI Program accomplishments at Stennis include:

► **Technology Transfer Center, through its Visiting Investigator Program (VIP), assisted U.S. industries** by providing remote sensing data to improve their commercial operations. (For more insights on the remote sensing capabilities at Stennis, see the case study on Hurricane Andrew on pages 20-21.) •

CENDI

CENDI is an interagency working group composed of senior STI managers from the NASA STI Program and the U.S. Departments of:

▶ **Commerce**—National Technical Information Service (NTIS)

▶ **Energy**—Office of Scientific and Technical Information (OSTI)

▶ **Defense**—Defense Technical Information Center (DTIC)

▶ **Health and Human Services**— National Library of Medicine (NLM).

These managers have responsibility for STI at agencies representing more than *90 percent* of the $70 billion Federal R&D budget.

The STI programs at these agencies have many common interests. CENDI was chartered in 1984 in recognition of this, and to maximize the opportunities for member agencies to share resources, avoid duplication of effort, and improve each agency's effectiveness.

CENDI is making significant progress in helping ensure that Federal STI is used to enhance U.S. economic competitiveness.

CENDI has been the focal point in working with other Federal organizations on STI policy and in supporting the improvement of U.S. competitiveness, particularly in the ways U.S. success is dependent on high technology. These include groups from both the executive branch—Office of Science and Technology Policy (OSTP), Office of Management and Budget (OMB), and Office of Information and Regulatory Affairs (OIRA)—and the legislative branch—Office of Technology Assessment (OTA).

CENDI also maintains a continuing dialogue with the National Academy of Sciences (NAS) for the development and analysis of STI issues.

In addition to these crosscutting agencies, NASA works with CENDI to meet with other agencies and with the private sector on topics of interagency interest. In 1992, these other organizations included the Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS), the Library of Congress (LC), the National Archives and Records Administration (NARA), the Association of Research Libraries (ARL), the American Association for the Advancement of Science (AAAS), and the Harvard Program for Science, Technology, and Public Policy.

CENDI activities emphasize cooperative programs, joint funding of special projects, joint efforts in data gathering and analysis on STI issues, and sharing database records. For instance, the NASA STI Program has ongoing exchange agreements with NTIS, DOD, and DOE to process computer tape input from each of these agencies.

Each CENDI agency has an extensive international program. CENDI helps ensure that the U.S. maintains the strongest position in STI negotiations *and* that the best use is made of foreign information received under each exchange program.

The NASA STI Program plays a key role at CENDI:

▶ NASA holds the chairmanship of CENDI's Networking Working Group, the special committee charged with determining how agencies can best cooperate in their development of STI networks and gateways.

▶ NASA is the lead agency in the CENDI Directory Project, which is looking at information directory (yellow pages) standards and the possibility of creating a directory network that would link each agency's online directory resources with a national STI network.

▶ NASA participates in the following other CENDI working groups and projects: Video and Non-Print Standards Project to look at new forms of scientific publishing; SGML Data Type Definition Project to explore how to format documents for electronic full-text transmission and storage; User Education Program to help promote information literacy; and Cataloging Standards Working Group to help develop compatibility in agency databases for economies of scale.

▶ In 1992, the NASA STI Program made contributions to an OSTP initiative to review policy aspects of STI in the context of the health of U.S. science and technology policy.

▶ In cooperation with CENDI, NASA helped develop implementation standards and procedures for the information components of the National Technology Preeminence Act of 1992. •

International Operations

Overview

Today, *more than half* of the world's scientific and technical information is produced outside the United States. What's more, offshore technology and science is now, in many areas, equal to or ahead of the United States.

At NASA, these facts are a cause for action.

For U.S. aerospace leadership and international partnerships to continue, NASA researchers *must* have rapid access to the spectrum of STI produced by both domestic and international sources.

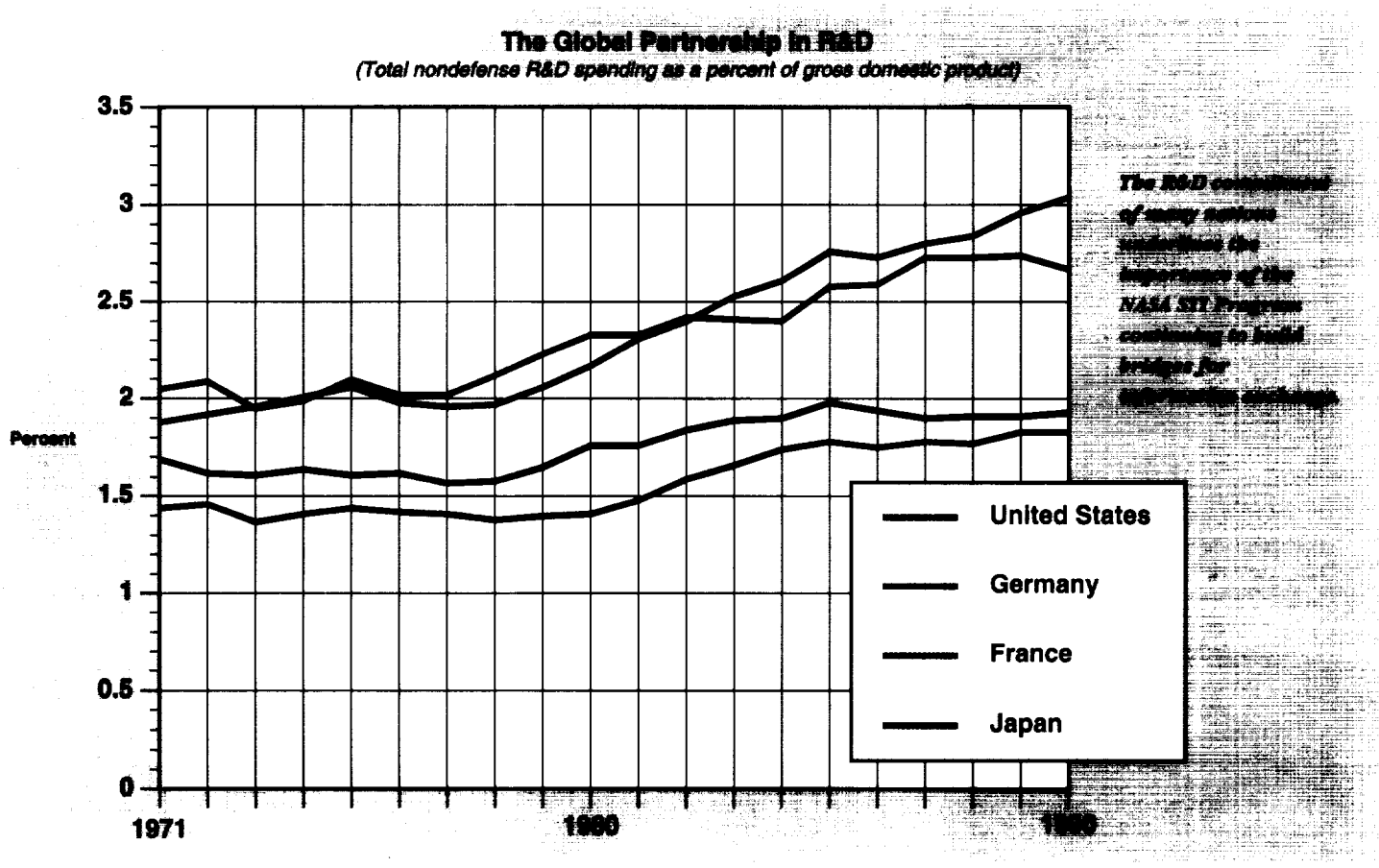
That's why the NASA STI Program continues to build bridges with a wide variety of STI sources worldwide. Two trends reinforce this need:

- Budget pressures here and abroad have increased the need for international cooperation. From the U.S. perspective, access to foreign STI has the effect of doubling or even tripling U.S. R&D budgets—with negligible cost to the U.S. government, industry, or both.
- U.S. leadership in critical technologies is being challenged by aerospace entities throughout the world.

In accordance with guidelines formulated by the STI Council, the NASA STI Program is committed to a review and expansion of the scope and coverage of the NASA STI Database. The Program's International staff has already begun to identify mechanisms that will help reach these goals. European organizations have made suggestions as well. Further, in the coming months, the Program expects to receive recommendations on expanded coverage directly from international contributors and users.

NASA STI Program representatives have met with NASA's International Relations (Code IR), to devise additional strategies and cooperative efforts for acquiring international STI. The STI Program is working closely with Code IR country experts to determine the NASA-related technology strengths of other nations. Next, the Program will identify documentation centers or acquisition channels, then develop exchange agreements appropriate to the new political realities of the 1990s.

One of those realities is that the Program is committed to ensure equity in



STI exchanges with its international partners.

Another reality—the increased importance of nations with developing aerospace programs related to topics such as global change—is the driving force behind the NASA STI Program's move to invite those nations to join its coalition. Greater attention given to nations such as Brazil will assist these countries in their growth and add to U.S. aerospace knowledge by disseminating the results of the work of each country's top researchers.

Expanding the scope of international aerospace information beyond research and development publications to numeric and image databases is yet another long-range direction. Recent developments in computer and telecommunications technology, taken in conjunction with a growing spirit of international cooperation, help make this goal attainable.

As for our daily activities, the international component of the STI Program continues to rely on three basic kinds of exchange agreements: bilateral, ESA tripartite, and national.

Bilateral Agreements

Dating from the mid-1960s, bilateral agreements were the earliest exchanges between individual foreign organizations and the NASA STI Program office. Many such agreements are still active.

In 1991, more than 70 foreign organizations sent us more than 2,800 reports and papers from Australia, Belgium, Brazil, Canada, the Commonwealth of Independent States, Czechoslovakia, Denmark, Finland, France, Germany, India, Israel, Italy, Japan, Netherlands, Norway, Papua New Guinea, Philippines, Poland, South Africa, Spain, Sweden, Switzerland, Taiwan, and the United Kingdom.

As just one step toward revitalizing current foreign exchange relationships,



Dr. David Abir (left), Professor of Aeronautics at Tel Aviv University and former President of the International Committee on Data (CODATA), and Dr. David Lide, NASA STI Program, recently met in Paris at the Headquarters of the International Council of Scientific Unions (ICSU) CODATA to discuss international data management issues.

the Program conducted a review of more than 200 bilateral document exchange agreements. The core question—are the exchanges equitable? The review looked at the volume of materials exchanged, identified nonperforming organizations, and initiated actions to revitalize nonproductive exchanges.

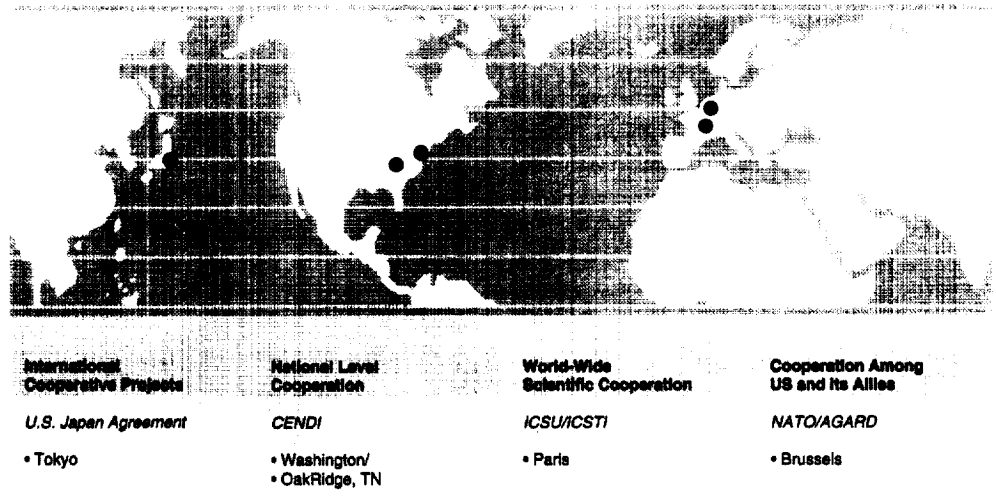
ESA Tripartite Agreements

Through ESA and its predecessor, the European Space Research Organization (ESRO), NASA has an umbrella relationship with the major Western European countries that dates back more than 25 years.

Today, this mutually rewarding association has evolved into a special partnership in which ESA acts as the consolidator of European input to NASA from various aerospace-related institutions, and as the distributor of NASA information back to these same institutions. As a major online European database host, ESA provides online access to the NASA Aerospace Database for Europe. (The NASA Aerospace Database contains citations to the richest supply of aerospace report and journal literature in the world.)

ESA has taken over management of many previous bilateral exchanges with European institutions in member countries under what are called NASA/ESA tripartite agreements.

The NASA STI Program has recently conducted a survey of the NASA/ESA tripartite exchange organizations. The Program received more than 80



The NASA STI Program participates in many national and international organizations that help strengthen member awareness of STI issues.

responses from all European countries. A detailed analysis of survey results has been completed and is being used for strategic planning regarding the NASA/ESA relationship.

In 1991, ESA provided NASA with 4,066 citations. Each was fully indexed and abstracted according to NASA specifications—making it ready for loading into the NASA Aerospace Database—*and* backed by copies of the complete reports. These reports were submitted to NASA by about 150 organizations from 13 Western European countries.



Thomas Labr (far left) and Michael Streeks (far right) of NASA and Naoko Nibei (second from left) and Miyuki Akiyama of the Technical Information Division of NASDA toured NASDA's Tsukiba Space Center during a preliminary STI exchange meeting.

Nation to Nation

In many cases, the NASA STI Program has adopted a national level approach in dealing with other countries. Under this strategy, NASA and the country's national organization handling aerospace activities sign a "Technical Protocol."

Countries are selected for protocols based on NASA interest in the country's R&D. Single countries in some cases are acknowledged leaders in select scientific and technical disciplines.

The protocols call for the NASA counterpart organization to act as the coordinator for the exchange of aerospace information between NASA and that country. Under this arrangement, the partner has access to NASA's Aerospace Database in exchange for that country's information...provided in specified formats compatible with the NASA information processing system.

To date, we have longstanding national level agreements with Canada, Israel, and Australia, and negotiations with Japan were completed in November 1992.

Nation to Nation Exchanges —A Closer Look

Israel—NASA signed the first nation to nation Technical Protocol in 1986 with the Israeli Space Agency (ISA). ISA is part of Israel's Ministry for Science and Development.

Australia—NASA and the Australian Department of Defence, Information Services Branch signed the Australian national agreement in early 1988. After a period of negotiation over cooperation in certain technical areas, the agreement was fully implemented in 1990.

Canada—In 1989, NASA signed an agreement with the Canada Institute for Scientific and Technical Information (CISTI) of the National Research Council of Canada. The agreement, which has been fully implemented, provides for the mutual exchange of both paper documents and bibliographic database information.

Japan—Negotiations were completed in November 1992 with the National Space Development Agency (NASDA) of Japan. The agreement calls for two phases of exchanges: in the first phase, paper copy and electronic citations from NASDA and other participating Japanese organizations will be exchanged for NASA documents. The second phase will provide Japan with access to the NASA Aerospace Database; this phase will begin when NASDA collects and prepares electronic citations for aerospace related materials from relevant Japanese organizations. •

AGARD

AGARD—the Advisory Group for Aerospace Research and Development—is an agency of the North Atlantic Treaty Organization (NATO) Military Committee. Founded in 1952, the agency's main tasks are to:

- ► Exchange information relating to aerospace R&D among NATO nations.
- ► Stimulate cooperation among the nations.
- ► Advise NATO's military committee.

AGARD's operations are carried out by nine technical panels. One of these—the Technical Information Panel (TIP)—is composed of information center managers and administrators as well as information specialists. All 36 TIP members are from NATO nations.

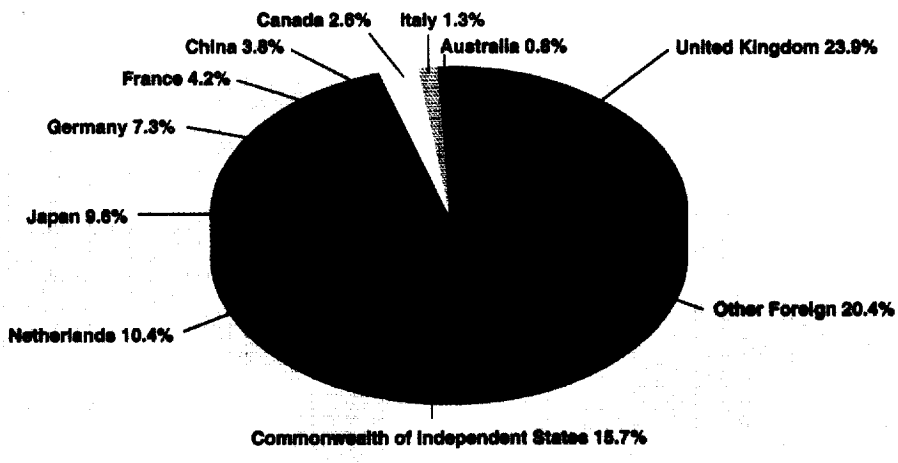
Recent AGARD developments in which NASA STI members played a key role include:

► **Installed NASA's Cotter as TIP Chair**—In October 1992, Gladys Cotter, Director of the NASA STI Program, was elected Chair of the AGARD/TIP. Cotter also serves as the U.S. Panel Coordinator for AGARD/TIP.

► **Developed STI Research Agenda**—NASA coordinated the TIP workshop in Lisbon, Portugal, which was aimed at developing a research agenda on issues related to STI management and policy. Attendees not only identified key developments and issues in information science programs, but recommended areas for further study.

► **Participated in Basic Documentation Practices Lecture Series**—In support of past AGARD publications on information management, Gladys Cotter and Walter Blados, International Specialist for the NASA STI Program, participated in a seminar to update the information in these publications and to help improve basic documentation practices. They lectured in Greece, Portugal, and Turkey on the mechanics of data transfer, the principles of responsible information exchange, coping with the proliferation of information, and the variety of media currently available.

International Contributors to the NASA STI Database *STAR* and *IAA*
Calendar Year 1992



The ten leading international contributors to the NASA STI Database help account for its depth, diversity, and value to users.

► **Compiled Factual and Numeric Databases Directory**—In cooperation with the other NATO nations represented on TIP, NASA compiled a directory of factual and numeric databases that have been developed by individual NATO nations. These databases may be made available for use by other nations. The directory is a pilot project consisting of about 120 database entries. It is hoped that the directory will prove useful, and that succeeding issues will significantly expand the number of database entries.

► **Helped to Implement Upcoming Projects**—Two important TIP projects under development are a workshop and seminar dealing with proactivity in information support and services, and a workshop on an international aerospace system. Ongoing efforts by NASA STI Program personnel are helping ensure the success of these projects.

Foreign Acquisitions Workshop

The NASA STI Program recently hosted the second Foreign Acquisitions Workshop for U.S. agencies active in acquiring foreign documents.

Under the theme of "Putting the Pieces Together in a Changing World," attendees participated in discussions addressing such international STI challenges as: dealing with the Commonwealth of Independent States; Eastern European developments; Translation: Human and Machine; and Optical Scanning and Optical Character Recognition (OCR).

The workshop included meetings and discussions of interagency cooperative programs, a look at technology impacting foreign acquisitions, and a keynote address by Dennis M. Bushnell, Associate Chief of the Fluids Mechanics Division at Langley Research Center. •

Case Studies Demonstrate the Compelling Need for International STI

Russia and the client states of the former Soviet Union are among the largest international contributors to the NASA STI Database. Dennis M. Bushnell of Langley Research Center is among the scores of NASA researchers who appreciate the value of foreign STI in general, and Russian STI in particular.

Most research at Langley is in aeronautics, focusing on ways to improve today's aircraft—and develop concepts and technology for future aircraft. Bushnell and his colleagues recently turned to Russian STI secured through the STI Program to accelerate advances in their work.

By giving NASA researchers access to STI that includes the current—and perhaps pioneering—work of international colleagues, U.S. researchers exponentially increase their opportunities to achieve breakthroughs. As an added bonus, these resources are made available to NASA researchers at a relatively low cost to this agency.

As the following examples demonstrate, building on earlier gains—a guiding principle for all researchers—holds true whether or not the previous work was conducted in the U.S.

These four abbreviated case studies show how Soviet research of the mid-1980s is helping NASA make crucial advances in the early-1990s.

1. **Heating leading edges for enhanced laminar flow control.** The leading edge, or most forward portion of a wing, serves an important aerodynamic function in establishing smooth airflow and efficient lifting power. The Soviet concept of heating the leading edge reduces wind "drag" by laminar flow control and improves aircraft aerodynamics.



At the second NASA Foreign Acquisitions Workshop, Dennis Bushnell stressed the importance of international STI exchange.

This concept, which refines similar work NASA has conducted for a number of years, will be incorporated into NASA research on subsonic transport aircraft.

2. **Using pressure sensitive paint for wind tunnel pressure mappings.** This innovation improves efficiencies in our wind tunnel testing *and* reduces costs.

Wind tunnels let researchers study the effects of air flow past objects. Scaling laws permit the use of models—such as airplane models—rather than full-scale objects.

The current U.S. approach is to make relatively expensive models with a variety of pressure sensitive orifices installed in them. The Russians, however, have developed a pressure sensitive paint to apply to the surface of the object being studied. Then the object is filmed under experimental conditions...and the motion picture provides the information. How? As the pressure levels change, so does the color of the paint.

3. **Producing long run time shock tunnels** using a reflection chamber upstream of a stagnation chamber, where multiple shock heating is generated. This could greatly enhance NASA research facilities and our ability to test aerospace flight, military rockets, and missiles—virtually any high-speed device.

Shock tubes are long tubes or pipes in which brief high-speed gas flows are produced by the sudden release of gas at high pressure into a low-pressure portion of the tube. The high-speed flow moves into the region of low pressure behind a shock wave. A shock tunnel is simply a shock tube used as a wind tunnel. In this new approach, the shock reflects back and forth in the chamber and produces run times 100 to 1,000 times those of conventional U.S. facilities.

4. **Using riblets to extend the transitional flow region and provide loss reductions in compressor blades.** This technique improves the efficiency of our aircraft engines.

NASA Langley invented riblets (small, longitudinal surface striations) to achieve turbulence skin friction reduction. The Russians demonstrated that extending the transitional flow region by using such surface riblets results in sizeable loss reductions for compressor and turbine blades. •

STI Program Headquarters

Headquarters duties fall into four broad categories:

1. **Program Direction**—Provide direction for the development, communication, and coordination of NASA STI policy, procedures, and standards.

2. **Information Management**—Acquire, manage, and provide access to relevant aeronautic and space science STI.

3. **Consultation**—Provide consultation and assistance to NASA program offices and activities in planning, developing, and implementing STI activities.

4. **Representation**—Represent NASA in a broad range of interagency, international, and domestic STI activities.

STI Council

The STI Council, made up of senior program-office and Center representatives, reviews current STI Program policies and goals. The Council ensures a range of perspectives on the Program from NASA's highest levels.

The Council was chartered in March 1992 under NASA Management Instruction (NMI) 1152.70. This NMI enumerates the Council's functions and criteria for Council membership.

In general, the Council provides impartial counsel to the NASA STI Program aimed at identifying:

- The STI requirements of NASA scientists and engineers
- Responsibilities regarding the widest practicable and appropriate dissemination of NASA information to the scientific and engineering communities at large, as mandated in the 1958 Space Act.
- The degree to which the NASA STI Program meets these requirements
- Any changes that should be made in the Program

Specific assignments carried out for the STI Council in 1992 are addressed in the following section, "User Services and Outreach," and in the separate chapter in this publication on TQM.

User Services and Outreach

The User Services and Outreach section has two main concerns: helping us learn more about our users, and helping our users learn more about us. Significant progress was made in each of these areas in 1992.

Several efforts provided valuable insights about our users: who they are and what they need.

STI Council Survey—At the request of the STI Council, NASA Centers surveyed users to learn more about their requirements and how to fill them. More than 500 users were queried in interviews conducted or coordinated by Center managers. Survey results are already helping to shape Program goals and strategies.

The most frequently cited comment among survey respondents was that users simply are not aware of the NASA STI Program and its many capabilities. In 1992, activities NASA-wide (as noted throughout this publication) were aimed at ensuring that NASA's "Best Kept Secret"—the NASA STI Program—achieves new and unprecedented visibility.

STI Users Group—The STI Users Group serves as a vehicle to expedite the flow of information between users and the Program and to assist NASA STI management in setting priorities. Guidelines for the group were established by a coordinating committee, whose members were drawn from each NASA Center.

User Services Plan—The User Services Plan provides a blueprint of the best ways to promote the STI Program among its many audiences. The plan's recommended activities are already under way. The plan structures these activities and recommends priorities in light of NASA's continuing resource constraints.

Recent initiatives on many fronts helped promote Program capabilities.

Exhibits—In 1992, the NASA STI Program exhibits team promoted Program products and services at a variety of conferences and trade shows:

- **American Institute of Aeronautics and Astronautics (AIAA) Annual Meeting**—Crystal City, VA, April 28-30
- **NASA STI Annual Conference**—Houston, TX, April 28-May 1
- **1992 Special Libraries Association Annual Conference**—San Francisco, CA, June 6-11
- **World Space Congress**—Washington, DC, August 28-September 5
- **Geographic Information and Spatial Data Exposition (GISDEX)**—Washington, DC, October 6-9
- **Society of Automotive Engineers (SAE) Aerotech**—Anaheim, CA, October 6-8
- **American Indian Science and Engineering Society (AISES)**—Crystal City, VA, November 5-7
- **Defense Technical Information Center (DTIC) Annual Users Conference**—Alexandria, VA, November 6
- **Open Source Solutions**—McLean, VA, November 30-December 3
- **Technology 2002**—Baltimore, MD, December 1-3.
- **International Online Information Meeting**—London, England, December 8-10.

Videos—STI Program Headquarters and Lewis Research Center produced the first video overview of the NASA STI Program. In less than six minutes, STI video viewers get a colorful, informative look at the Program's people and its products...and how they help meet a diverse range of researcher needs every day.

Copies of this, the first NASA STI Program video, have been distributed to

the NASA Centers. Additional copies are available upon request to the NASA Access Help Desk.

Publications—In 1992, we introduced a variety of brochures and related print materials for use at our Centers and at STI Program exhibits. Publications included this piece's predecessor, "Prologue to the Future," and a six-panel overview of the NASA STI Program, "Reaching Out to Serve You." These and similar publications communicated the Program's commitment to meet user needs.

STI Program Representatives at NASA Headquarters—To shorten internal lines of communications, several members of the STI Program Headquarters staff have assumed liaison duties at NASA Headquarters with managers in the R&D program offices, as well as Public Affairs, Legislative Affairs, and International Relations.

Researcher Communication—Efforts to raise researcher awareness of NASA STI Program capabilities have included STI Program staff presentations on critical aspects of Program technology to researchers at conferences, meetings, and workshops.

NASA Access Help Desk—To help publicize this new service (see p. 9), the STI Program exhibit team distributed business cards containing relevant Help Desk information to visitors to the STI booth.

One of the best opportunities in 1992 for communication among STI Program members was the **NASA STI Annual Conference**, held April 29-May 1 at the Johnson Space Center. Included among the approximately 100 attendees were representatives from NASA Headquarters and all Centers.

The focus was on key issues related to the Conference theme, "A New Information Era." Attendees exchanged ideas on new technologies and their application in a changing STI environment while enjoying a selection of lectures, panel discussions, and workshops. Sessions included an update on Program services and the results of the NASA-wide STI Program review performed for the Scientific and Technical Information Activities Committee, chartered by Samuel W. Keller, then NASA Associate Deputy Administrator.

Langley Research Center will host the next STI Annual Conference, to be held in Williamsburg, VA, during the week of May 24, 1993.

Information Services

Matching NASA STI Program users with the information they want is one of the Program's primary goals. Progress in upgrading and revising existing procedures to meet that goal moved forward rapidly last year.

Three-day Turnaround Plan Implemented—In 1992, to find new and better ways to improve our response time for filling orders, we implemented a three-day turnaround plan. The goal was to process more than 90 percent of document requests from CASI users in three days or less. By the end of 1992, we had reached that goal, processing more than 95 percent of requests within 3 days of receipt. The most common reason a document takes more than 3 days to process is that it has to be retrieved from an outside source.

Innovative Approaches Developed to Ensure Our Products and Services Are Timely and of Unwavering Quality—Here are just two projects that address this goal.

CASI is undergoing a microfiche processing review. To ensure high-quality microfiche for our users, we're stepping up our efforts to guarantee that the microfiche we receive from external agencies meet NASA standards. We notify the organizations that supply our microfiche when they aren't meeting our quality standards, and tell them that we're eager to work with them to improve the quality of their microfiche.

Further, we've established long-term quality control testing through an independent contractor, who will evaluate a portion of the microfiche we produce. As a long-term quality control effort, we're continuing to inspect our microfiche duplication to ensure our standards are being upheld.

CASI Microfiche Archive Reviewed. A cursory inspection of nearly one million of the three million microfiche in the CASI archives has shown that only a small portion of these microfiche are deteriorating, unusable, or both. CASI plans to re-film these items in the near future.

Now we're focusing our attention on the process of making paper copies ("blowbacks") and using new duplicators to ensure that succeeding "generations" of microfiche retain the quality of the master copy, thus improving the blowback process. Plus, we've purchased an additional blowback machine. This additional machine means additional reliability... and less time required to fill orders.

Documents Re-Filmed. Many of the original documents in our CASI collection were microfiched on acetate-based film according to the standard of the day—5" x 8". (Now we use polyester-based film, which is more durable and easier to store.) Today, we can't reproduce documents from microfiche in this outmoded size.

To increase the amount of information we can deliver to users, we've retrieved and re-filmed nearly 300 documents captured in the earlier

format—each re-filmed according to the latest micrographic standards.

CASI Infrastructure Upgrade Initiated. We've initiated a multiyear plan to upgrade the CASI infrastructure. The initial improvements discussed below primarily address CASI computer and communications capabilities:

► **Optimizing Internal Systems**—To improve these systems, we've implemented an Ethernet Local Area Network (LAN). LAN workstation-based architecture is cheaper and easier to maintain. All the workstations used for internal systems such as accounting and registration have been connected. We have electronically linked the Crystal City operation with the CASI and are using electronic mail to communicate more efficiently. For the future infrastructure, we will use an open system, client/server design. This design will utilize an Ethernet LAN, Windows-based workstations, and an Oracle server.

► **Enhancing Desktop Publishing**—We've accomplished this upgrade—and the related capabilities of graphics design and imaging—by adding additional microcomputers. This has simplified and speeded up the design and production of our publications.

► **Improving Tape Storage and Exchange**—The NASA STI Program has tape exchange agreements with many agencies in the U.S. and STI partners around the world. Our new tape system lets us copy our database onto cartridges instead of 16-track tapes. Cartridges hold more data, and they make tape interchange easier than ever.

Dissemination of Bibliographic Information Improved. At CASI, documents used to be processed according to the *STAR* publication cycle, which took about three months. Beginning in March 1992, most documents became available to users within two weeks of receipt at the CASI. We achieved this by altering the document processing cycle to ensure documents are available for distribution as soon as they are announced on RECON—instead of being unavailable until they are announced in *STAR*.

STI Acquisitions, Processing, and Delivery Systems Upgraded. In April 1992, the Program released a comprehensive analysis of our current processes for database building, order processing, and inventory management. On the input side, areas of improvement were identified to upgrade the quality and efficiency of the processes. On the output side, the recommendations focused on improving customer service and improving the quality of our document reproductions. That analysis generated a queue of specific actions to be completed over the next 12 to 18 months.

Remote Access to CASI Streamlined. At one Internet address, STI Program registered users anywhere in the world now have direct computer-to-computer access to a variety of CASI systems. (The Internet is a computer network that many Federal agencies, universities, and private companies use to exchange information worldwide.)

Users are greeted with a menu giving them system choices, such as ARIN, RECON, or SYSTRAN (the Program's translation system). Prior to this upgrade, many users accessed CASI by way of a relatively complex, time-consuming electronic route.

Database Content Upgraded. In July 1991, the Program initiated a project to upgrade the data in the NASA STI Database. The project addressed issues of Database quality and coordinated quality improvement efforts by the two Database producers, CASI and TIS.

Guiding principles included **consistency** (the type and scope of data in each field and the format in which the data are entered should be the same for all input producers), **granularity** (each piece of information should be stored in a separate field to facilitate access for searching), **accessibility** (the number of fields that can be searched should be expanded to meet user needs), **simplification of input** (data element content and format should not be restricted by the limitations of input processing or publications production software), and **selecting the right kinds of data** (the fields should meet customer needs).

RECON users began seeing Database improvements from this project by the end of July 1992. Further enhancements followed, with each announced in a new Program publication created for that specific purpose, "RECON Alerts." Today the process is continuing.

Translations System Improved. The STI Program has upgraded its translations services with the development of a database management system. The system keeps an electronic record of our translation vendors—their capabilities, prices, turnaround time, etc. It also tracks orders, generates translation invoices, and automatically debits user accounts.

Additional Developments

In 1992, several projects in addition to those already mentioned helped the NASA STI Program ensure its products and services continue to meet, and even anticipate, user needs.

Multimedia Initiative. The most obvious benefit of multimedia is its ability to deliver information in the most effective format so there are no barriers to understanding. Multiple media—text, graphics, sound, and motion—are integrated through digital technology to deliver users an unequaled communication experience. The goal of this rela-

tively recent STI Program initiative is to bring the many benefits of multimedia information delivery to NASA users.

As a first step in this initiative, the CASI will become the central repository for all NASA-produced videos. The videos will be cataloged and announced on RECON. CASI will be able to archive and replicate videos for Program users on a mass basis beginning in early 1993. The Program will also serve as the source for videotapes of NASA Select television programs.

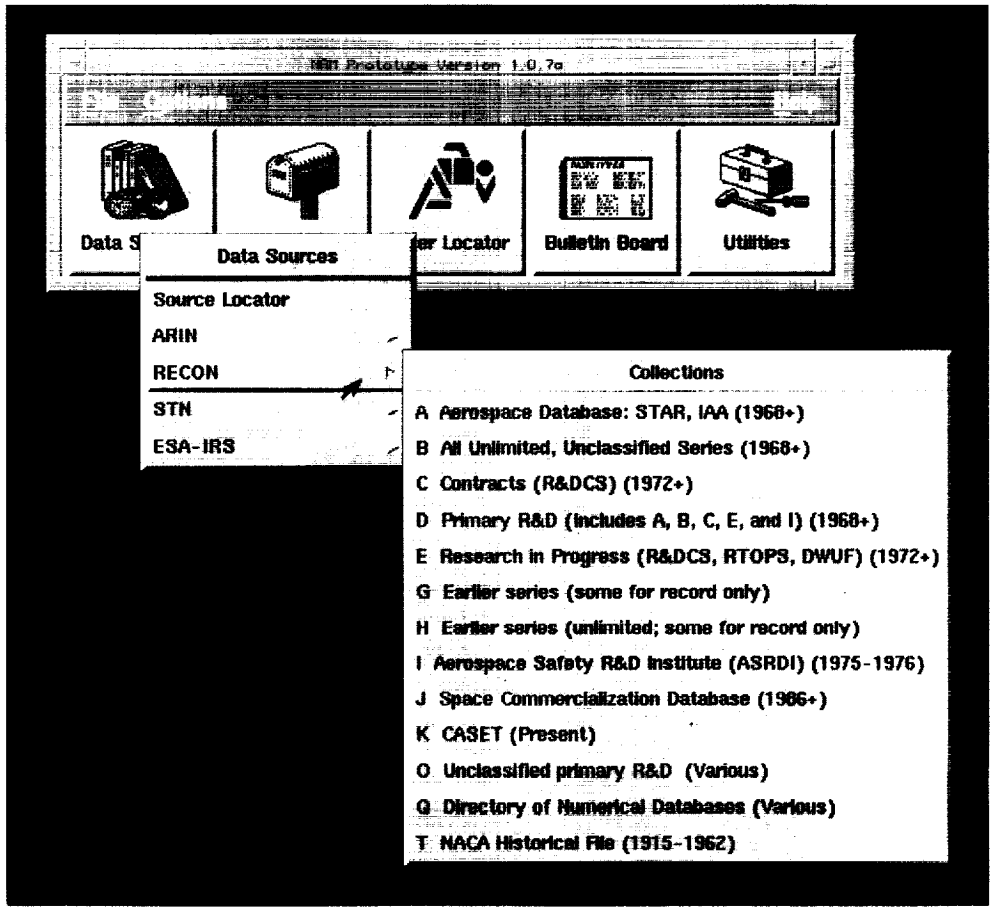
RECON Front-End Project. To streamline access to the NASA STI Database and, at the same time, make RECON more user-friendly, the Program is exploring the potential of two search and retrieval engines. Each is available with *no* additional budget requirements.

► WAIS (Wide Area Information Server)—With more than 100 databases and 5,000 users worldwide, WAIS is rapidly becoming a standard for information distribution via the Internet. For no charge, the U.S. Geological Survey in Reston, VA, has already taken RECON information and indexed it with WAIS software.

► NOTIS is an integrated library management software package that is currently configured to operate with the Program's ARIN database. The NASA STI Program has developed a prototype using the Public Access Catalog of NOTIS to test how user-friendly this new access method is to RECON information.

Completion of the prototype and testing phases on the RECON Front-End Project is expected in 1993.

NACA Documents Project. During its more than 40 year history, researchers associated with the National Advisory Committee for Aeronautics (NACA), NASA's predecessor, conducted seminal research on all aspects of aeronautics. Today, many aerospace researchers are convinced that those NACA documents remain an extremely valuable resource for their own work.



Using NAM's main menu, you can choose among several useful functions. One of these gives you easy access, through RECON, to additional sources of STI worldwide.

Through the NACA Documents Project, definitive online bibliographic records are being created in ARIN for more than 14,000 NACA formal documents, as the first phase of the project. The target completion date for entry of these bibliographic records, including some abstracts and available NACA indexing terminology, is August 1, 1993. The STI Program Headquarters team coordinating this effort expects that most of the NACA holdings of NASA Center libraries will also be recorded by that date.

CASI staff members have entered many of the NACA records. Ames, Langley, Lewis, Headquarters, and Redstone Scientific Information Center are also creating original bibliographic records. These locations, along with Johnson, Kennedy, and Dryden, are also participating by checking the quality of the records and adding holdings information.

NASA Access Mechanism (NAM) Prototype. The NAM prototype assists NASA researchers in their search for STI

worldwide. It provides a "point and click" interface which enables users to search databases (including the NASA STI Database), use Internet utilities and bulletin boards, and locate and contact their peers, while simplifying user interaction with these systems. NAM's communications capabilities allow users to have access to colleagues and information sources around the world from their desktops.

NAM components together provide a powerful tool to exploit information sources. For example, the Resource Locator assists users in identifying pertinent sources of information for their subject area, and then connects users to the selected information source(s). The User Interface provides flexible, easy-to-use forms to assist the user in querying remote databases, and provides results with easy tools for printing, mailing, or transfer to the user's workstation. The NAM's Electronic Mail and Peer Locator simplifies communication with other NASA researchers and peers in the global Internet community.

The NAM was first demonstrated in April 1992 at the STI Program Annual Conference at JSC and was demonstrated to limited audiences during the summer of 1992. In response to comments received from these audiences, the NAM has been modified, and a beta version of the NAM is being tested by a number of volunteers at NASA Centers for several months. These beta tests will evaluate the utility of the NAM; participants' comments will be collected periodically. A final report on this system architecture and its usefulness to the NASA STI community will help the STI Program determine the most effective system for application NASA-wide.

ASTRO/CD. The NASA STI Program's new CD-ROM, *ASTRO/CD* (Aerospace Scientific and Technical Research On CD-ROM), was introduced at the Annual Conference at Johnson Space Center. This Headquarters-produced CD covers the major bibliographic files entered into the NASA STI Database over the past five years. Special searching features make using it both easy and effective.

After a test period of our *ASTRO/CD* prototype at the NASA Centers, feedback will be solicited from each of the participants. We plan to produce a production version of *ASTRO/CD* based on recommendations from prototype users.

ASTRO/CD is expected to be added to the STI Program family of information products and services in 1993. A one-year subscription will include periodic disk updates.

NASA Printing. NASA printing professionals attended the 1992 Printing Manager's Conference, held in Philadelphia, PA, April 2-3. The Conference provided an open forum for attendees to address a variety of printing issues.

Several NASA Centers' printing plants are being downgraded to duplicating facilities, as mandated by the Joint Committee on Printing (JCP).

As NASA printing plants are phased into duplicating facilities, the NASA Printing Officer is committed to maintain maximum quality and productivity in operations NASA-wide. One vehicle to achieve that goal, electronic publishing, has the potential to make NASA printing more cost-effective and productive than ever before.

The JCP has asked to review the findings from NASA electronic publishing tests, currently being conducted at JPL, Lewis, and Headquarters. It is possible that the JCP will endorse the NASA approach to electronic publishing and make it a blueprint for other Federal agencies to follow.

Since its founding, NASA has devised cutting edge technology in virtually every area of its aerospace activities. The bank of practical knowledge these innovations represent provides a broad foundation for the U.S. public and private sectors to develop secondary technology applications or "spinoffs."

In the past 30+ years, several thousand applications have been fashioned in such fields as aeronautics, communications, health and medicine, public safety, the environment, and transportation.

Beyond the obvious gains of these innovations to the public sector and many of our nation's businesses, spinoffs also bring Americans an improved quality of life and enhance U.S. competitiveness.

NASA's chief link with the U.S. public and private sectors in this vital information chain is NASA's Technology Transfer Division, a component of NASA's Office of Advanced Concepts and Technology. Support for all elements of this network is provided by the Technology Utilization Office at the CASI.

Technology Transfer's implementation mechanisms include six Regional Technology Transfer Centers (RTTCs); *NASA Tech Briefs*, a NASA-sponsored publication; and COSMIC.

As for the NASA STI Program's role in this process, Technology Transfer is part of our user community. Every RTTC subscribes to the NASA STI Database. At each location, RTTC professionals use the NASA STI Database as a tool for identifying scientific and technical literature that can be transferred to their clients. Some of the documents those searches identify have been produced by the NASA STI Program.

In addition, every month more than 210,000 senior engineers, project leaders, and managers read *NASA Tech Briefs* and learn about NASA developed technology available for transfer. Among Technology Transfer's most important resources are the online versions of individual *Tech Brief* entries, which are stored on the NASA STI Database. Each entry is retrievable for users via RECON.

Regional Technology Transfer Centers. Members of the U.S. public sector and commercial industry can turn to the RTTCs to learn about NASA technology available for transfer.

Northeast
Center for Technology Commercialization
Westborough, MA
(508) 870-0042

Mid-Atlantic
University of Pittsburgh
Pittsburgh, PA
(412) 648-7000

Mid-West
Great Lakes Industrial Technology Center
Cleveland, OH
(216) 734-0094

Southeast
University of Florida
Alachua, FL
(904) 462-3913

Mid-Continent
Texas A & M University
College Station, TX
(409) 845-8762

Far West
University of Southern California
Los Angeles, CA
(213) 743-6132

From October 1, 1991, through September 30, 1992, RTTC search professionals made more than 1,300 RECON searches to benefit members of the U.S. public and private sectors.

Here are a few examples of recent technology transfers in which the NASA STI Program played an important support role.

NASA Technical Paper (TP) 3216, entitled "Cable Compliance," is a NASA publication that's having a very big impact on a non-NASA audience.

The 133-page document covers nearly 18 years of pioneering R&D at **Goddard Space Flight Center** on cable compliance. The GSFC Publications Office assisted in compiling, rewriting, editing, and publishing this notable paper.

The principal author and architect of the paper's major findings is James J. Kerley, a GSFC inventor who has spent nearly 50 years in engineering. Possibly one of his cable-compliant devices will one day be used to aid docking of the Shuttle or other spacecraft in its rendezvous with Space Station Freedom.

But when enterprising engineers at ITAC Systems, Inc. of Dallas, TX, recently studied "Cable Compliance," their thinking was much more down to earth. ITAC is working on a "joystick" of sorts that will allow user input to three-dimensional graphics programs for high-performance computers, such as those in the HP-9000 family or the Sun SPARC family. The joystick's ergonomic features, an outgrowth of Kerley's compliance joint research, will give users tactile feedback, thereby putting ITAC's product in a class by itself.

If ITAC's Kerley-inspired product succeeds, as company General Manager Don Bynum thinks it will when it is introduced in 1993, ITAC profits could soar.

ITAC first learned about Goddard's compliance technology through the pages of *NASA Tech Briefs*. After reviewing the appropriate *Tech Briefs* applications package, then studying TP 3216, Bynum and the company founder, Bob McLaughlin, decided to visit Kerley and his team to brainstorm about the commercial possibilities. Coordinated by the



As it scales towers, the cable-compliant robot looks, and moves, like a caterpillar.

Goddard Technology Utilization staff, the visit went very well and, now, ITAC is working to license the technology for use in its next generation of products.

Researchers with Mantech (Management Technology) Corporation of Fair Oaks, VA, also found "Cable Compliance" helpful in their work. Mantech, a $200 million company with 3,000 employees, is developing a very different compliance product—a mechanical caterpillar that can slink into all kinds of out-of-the-way places.

Like a caterpillar, the machine moves by choreographing a ripple of steps along a segmented body. Each body module has two U-frames that face each other and are joined by cables. Actuators enclosed by each pair of U-frames expand and contract in a computer-controlled rhythm. To pull the device along, gripper feet alternately seize then release whatever surface the robot is creeping over.

Possible uses for their device include inspecting ship hulls, painting bridge girders, and microtunneling (trenchless pipelaying). The caterpillar is a spinoff of the Goddard-developed cable robot.

No one can predict the incredible number of additional products that could be inspired by the research documented in "Cable Compliance." "Walkers, prosthetic knee joints, elbow joints, and wrist joints are among the long list of possibilities," says Kerley, who was named Goddard Space Flight Center Inventor of the Year in 1991.

Now, with requests for "Cable Compliance" pouring in from scientists and medical workers from around the world, the prospects for new cable compliance products are, seemingly, endless.

At **Langley Research Center**, the STI Program is implemented through the Research Information and Applications Division (RIAD). One of that Division's components is the Technology Utilization and Applications Office (TU & APO), which reports to the NASA Headquarters Office of Advanced Concepts and Technology.

In 1991, NASA's Technology Utilization Office's Applications Engineering Program at Langley transferred patented Langley technology for ultrasonically measuring skin burn depth to Topox, Inc., of Chadds Ford, PA.

In 1992, this technology became manifested as the Topox Supra Scanner. The Supra Scanner is now being marketed in the United States and will soon be available overseas.

Each year, about two million Americans suffer serious burns. A large percentage of burn patients require hospitalization and, typically, more than 10,000 die from their injuries.

The Supra Scanner is an offshoot of NASA ultrasound technology, originally developed to detect microscopic flaws in aircraft and spacecraft materials. The Supra Scanner is an advanced diagnostic instrument that makes immediate assessments of burn damage possible. This knowledge permits improved patient treatment and may even save the lives of seriously injured patients.

The Supra Scanner can also help reduce the risk of infection and guide treatment for such skin disorders as precancerous and cancerous lesions. Plus, it can aid in the diagnosis of lymphatic maladies.

Several other groups played important roles in the development of the Supra Scanner.

The NASA Technology Applications Team at Research Triangle Institute, Research Triangle Park, NC, assisted NASA Langley by performing an in-depth needs assessment and by coordinating the commercialization of this technology.

Langley researchers collaborated with the inventor of the Supra Scanner, now the President of Topox, Inc., and clinicians at the Medical College of Virginia (MCV) in prototype development and testing. Following clinical tests at MCV and the University of Aberdeen, Scotland, the Topox Supra Scanner was granted FDA approval.

Photos of the Topox Supra Scanner were taken and developed by personnel from Langley's Photographic Section, RIAD. RIAD took shots of both the instrument and a closeup of a skin scan.

"The photographics and video sections here help us with shots for many projects, not just the Supra Scanner," says John Samos, consultant and formerly Head of the Langley TU & APO. "We always need something for our records...and we also need something to show our commercial clients. As they say, a picture can be worth a thousand words." •

TQM Chronicle

Everybody's talking about Total Quality Management, or TQM. Its origins may reveal why.

TQM grew out of the work of an American, W. Edwards Deming. During World War II, our Government asked Deming to analyze U.S. companies participating in the war effort and formulate how they might operate more efficiently. His findings, which later became known as TQM, helped us win the war.

A tool as powerful as TQM can help America today, too. We need to use every available resource to meet worldwide challenges and ensure NASA's progress in aeronautics and space science.

At NASA, the thoughtful use of TQM can foster significant improvements at every level of this organization.

The unqualified dedication of the NASA Administrator to TQM is well known. Following his lead, the NASA commitment was amply demonstrated in 1992. TQM advocates could be found in every code in Headquarters, in every NASA Center, and at every level of our organization.

Similarly, as the agency was using TQM to help build a new and better NASA, members of the STI Program were rethinking and rebuilding this Program in the TQM mode.

The new management team at NASA STI Program Headquarters started putting TQM in place two years ago, mindful that creating a constancy of purpose—holding a clear view of where we were headed—should be one of our first tasks.

Work began on a Strategic Plan in 1990, and it was completed in 1991. The plan focused on Program goals, along with the changes needed to achieve those goals. In the same spirit, we are now at work on an outgrowth of our initial Strategic Plan—a five-year, Long Range Plan. This "grand design" will feed back into our modernization efforts and help us set priorities.

In another sense, the NASA STI Program has had a TQM orientation since the Program's founding. TQM says that one way to improve quality is by improving processes. Literature searches, one of our chief services, are a simple yet vital service for NASA researchers rooted in the need to eliminate redundancy and thus improve the R&D process. The savings these searches bring to NASA every day is incalculable.

TQM has other common themes that ask such basic questions as:

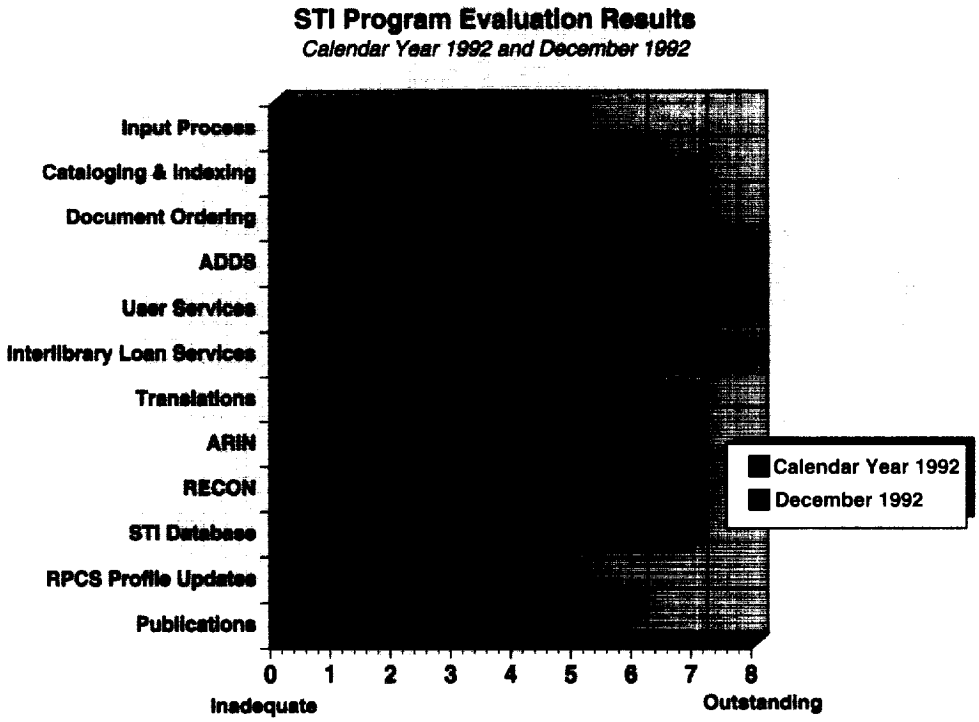
- ▶ Who are our customers?
- ▶ What services do our customers need from us?
- ▶ How well are we providing those services?
- ▶ How can we improve?
- ▶ How can we combine forces to serve our customers better?

As simple as TQM appears at the outset, closer scrutiny reveals a demanding system in practice. TQM asks far more of us than that we simply do our job. To reap the system's benefits, we must come together and study customer needs, examine present operations, eliminate unnecessary steps, and become willing to take risks as we try new methods. Above all, TQM demands communication and cooperation.

The following recounts TQM successes throughout the NASA STI Program. These accomplishments are a prelude to future progress...each gain geared to enhancing this Program's value to NASA and, ultimately, NASA's value to the U.S.

The Bottom Line

The bottom-line challenge to the NASA STI Program is this: Are we



providing the products and services our customers need?

In 1991, the newly established STI Council suggested three customer focus tools that, when completed, would address this challenge and related issues:

1. Determine the basic requirements for the STI Program.

2. Devise methods to improve the NASA STI Database.

3. Determine the benefits of the Program to its users.

This analysis was completed in 1992. Through it, we reinforced our awareness that users want information quickly, completely, accurately, and at the lowest possible cost—all quality issues. Findings delivered to the STI Council explored these requirements and identified new access and delivery methods for STI, and the cost and impact of each.

Realizing that TQM requires communication and cooperation, the Program is focusing on channels of communication between the NASA STI Program and our users. Formed in 1992, the STI Users Group is assessing responsibilities in the information chain, highlighting issues that need investigation, and helping the Program and our users learn more about each other's expectations.

Daily communication between users and the Program were enhanced through the recently established NASA Access Help Desk. The Help Desk offers users rapid access (hence, its name) to timely information on all aspects of STI Program products and services.

Since better communications at every level of our operation translates into improved service to our users, links between STI Program Headquarters and NASA Centers were strengthened through such new vehicles as the Monthly Center Evaluations, Monthly News Update, and STI Action Polls.

Monthly Center Evaluations—In January 1992, NASA Centers began sending monthly input to Headquarters regarding STI Program products and services. Headquarters makes every effort to respond promptly to these concerns and make changes, as needed. This Center feedback is also providing valuable statistical data Headquarters can use to benchmark progress in various Program areas.

Monthly News Update—Introduced in August 1991, this popular communique updates Center STI Managers on Headquarters activities. Distribution has since been expanded to include chief librarians.

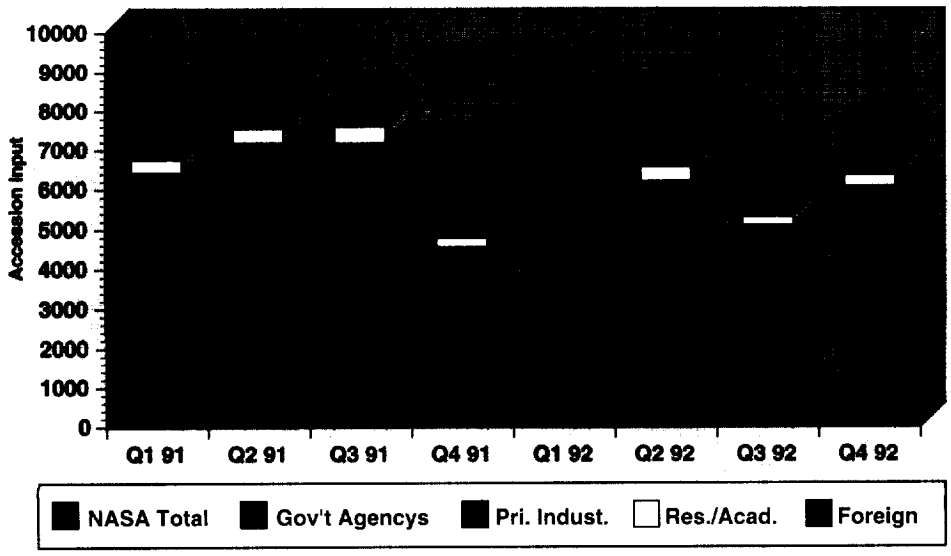
STI Action Polls—These Action Polls offer Centers a unique opportunity to comment on various actions proposed by Headquarters. Feedback from the polls, which are distributed in tandem with the Monthly News Update, provides Headquarters with valuable Center input on the pros and cons of implementing these actions.

Remembering that, "If you can't measure it, you can't manage it," the STI Program also inaugurated a number of metrics for setting and tracking target benchmarks for the Program (see charts at left, and on page 46).

At the CASI, problem-solving cross-functional teams have been addressing a variety of problems, such as instituting the three-day turnaround, upgrading the NASA STI Database, and developing innovative approaches to ensure our products and services are timely and of unwavering quality.

Further, in April 1992, after an exhaustive study of CASI operations, the Program released the first comprehensive analysis of our current processes of database building, order processing, and inventory management. The queue of tasks generated from this analysis will produce significant improvements in the

Accession Series Input by Source and Quarter



STI Program evaluation results (tabulated from user input) and accession series by source and quarter are just two metrics of STI Program progress.

quality of CASI processing in the months and years ahead.

TQM at the NASA Centers

At the **Headquarters S&T Library**, a special collection vigorously supports NASA's TQM initiative. A new TQM section comprising materials from the library's Quality/Productivity Awareness Collection and Program and Project Management Collection was created in 1992.

Resource lists covering TQM topics such as benchmarking, measurements, leadership skills, organizational change, and management methods have been produced by the library and are available to library patrons.

The library is applying TQM techniques to its internal operations. Streamlining of the library's acquisitions process during fiscal year 1992 is speeding the purchase of scientific and technical books, journals, and documents for the library and the NASA community.

The TID at **Ames Research Center** is integrating Total Quality Management into its culture. One way the Division has integrated TQM concepts into daily routines was by establishing better communication between TID managers and personnel. One highly successful example was to charter a Steering Committee of Division managers, which developed a Division Vision Statement and 10 long-range goals. The Vision Statement and goals were presented to the staff in a series of All-Hands meetings.

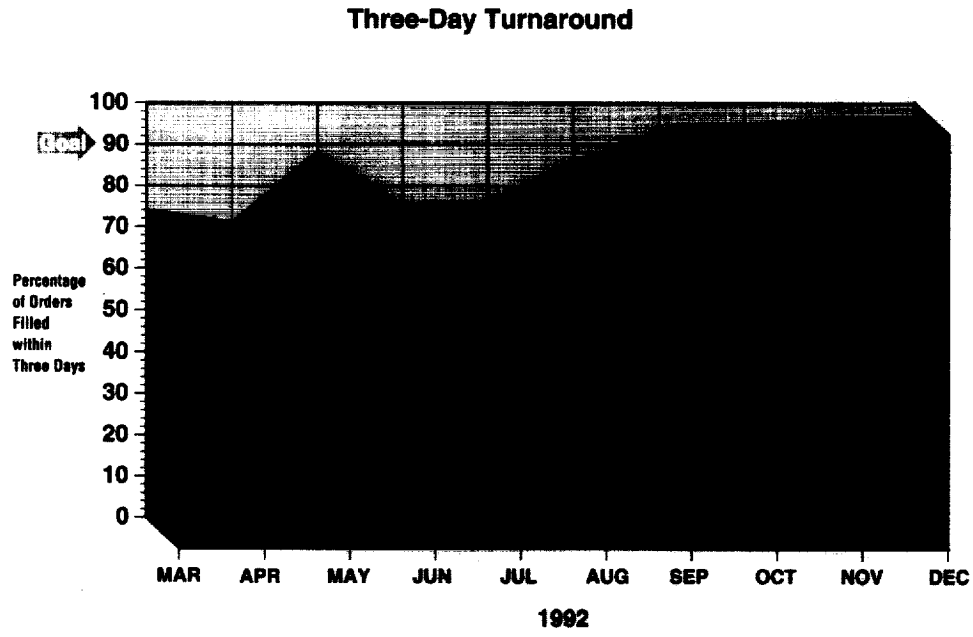
As a result of these meetings, personnel were able to devise a host of strategies and tasks for implementing the long-range goals. These strategies and tasks were clustered as they related to each of the 10 goals. From these clusters, committees were established to look at how to implement employee recommendations.

The Open House Committee held an open house event to acquaint the Ames research community with TID capabilities and explain how the researchers could best use these services. The Open House also gave TID the opportunity to ask researchers what their needs are and what is important to them.

The Technical Action Committee (TAC) acts as a vehicle for the transfer between management and staff of information concerning ADP development, and the Employee Recognition Committee established criteria for awards to recognize new ideas and procedures. To improve communication and help people in the various TID branches get to know one another better, a Division newsletter, called *TIDbits*, was started by the Publications Committee.

Michael V. Woywod, NASA STI Manager at **Goddard Space Flight Center**, represents NASA on the TQM Subcommittee of the Federal IRM Policy Council. In that capacity, Woywod is helping to identify and formulate Federal policy regarding TQM policy and practices.

In 1992, TQM activities at GSFC were evident in both Library Services and Technical Information Services. The GSFC Library set up a display focusing on its TQM collection. A pathfinder (reference guide) and booklist were compiled as customer giveaways. The TQM collection covers strategic planning, teamwork and quality circles, quality



In 1992, the response time for CASI to fill orders improved dramatically. As this metric suggests, the portion of document requests filled in the targeted benchmark of three days or less rose from 74 percent of orders in March 1992 to more than 95 percent by year's end.

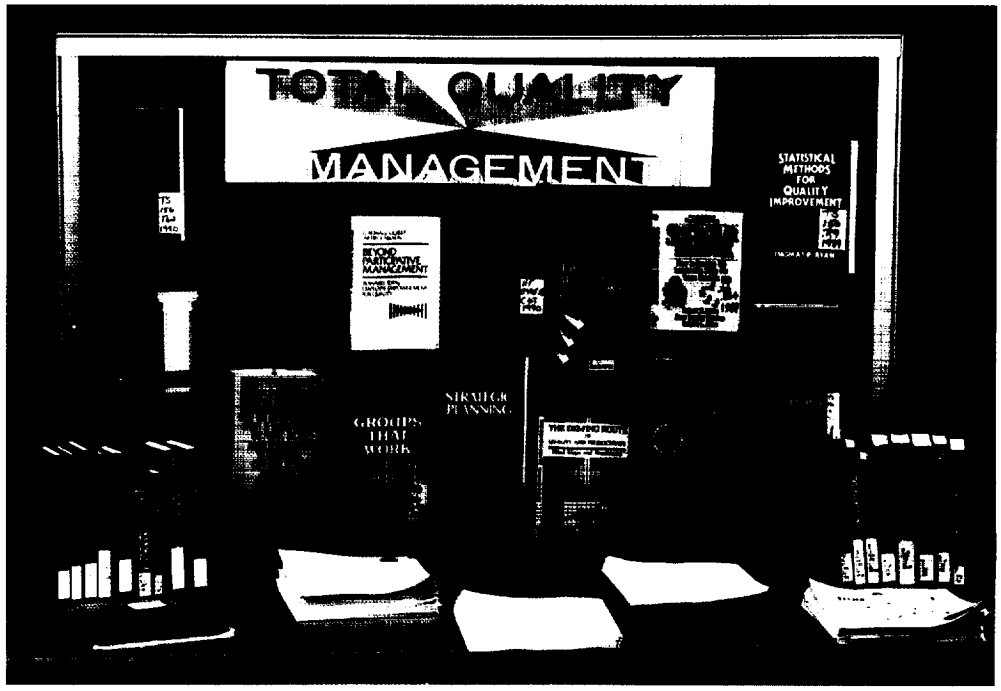
control, employee empowerment, measurement and analysis, and customer focus. More than 200 copies of the pathfinder and booklist were picked up from the display.

The GSFC Library has many stakeholders, including customers, contractors, and upper management. To involve these groups in establishing priorities for library operations, the Library Services Branch set up a joint effort with the Library Council to develop a strategic plan and prepare an action plan to meet future resource needs. The group will make a presentation to GSFC's Institutional Planning Committee (IPC) which impacts the Center's resource allocations.

Motivated by the goal of improving customer relations and emphasizing a service orientation within the Branch, the Publication and Graphics Services Section developed their own Quality Control Procedures Manual. The Publications and Graphics groups each worked as separate teams to craft their quality control principles.

At GSFC, 1992 was the year of the "Consolidated Contract" in the Technical Information Services Branch. Previously, the branch has been supported by five major contracting firms and several smaller Blanket Purchase Agreement contractors. To tighten up operations, all five contract areas were rolled into one "consolidated" contract, which brings greater efficiency to managing the contract and to the services provided.

As part of the Total Quality Management Program at the **Jet Propulsion Laboratory**, its Graphics Vending Services Group conducted two surveys, one for in-house customers and one for off-Lab vendors. Response to the surveys was enthusiastic and resulted in significant changes. Vending office hours were extended, vendor computing capabilities were expanded, and a computerized estimating service was established, allowing customers to receive cost estimates in real time as jobs were vended.



The GSFC TQM display remains a popular source of TQM materials for library patrons.

As part of the **Johnson Space Center's** TQM effort, a center-wide critical process team was formed in 1992 to evaluate the services and funding of the STI Center. The team was made up of managers representing virtually all JSC organizations. Members conducted user surveys and assessed impacts of reduced funding to the STI Center on their individual programs and projects. As a result of this team's findings, full funding was restored to the STI Center's materials budget for fiscal year 1992.

At the **Kennedy Space Center**, TQM activities were evident at the KSC Library and in Publications.

The library established an Outreach Program, which includes two levels of tours: a brief overview of services; and an in-depth tour with training on automated services, including the online catalog and RECON. The tours are advertised in the local newsletter, the *KSC Bulletin*.

Briefings to remote KSC locations are available, by appointment. The library also produced an updated brochure and detailed "how-to" instructional sheets on using various automated library services, such as CD-ROMs and commercial databases.

The KSC Publications section also established an Outreach Project to brief organizations or groups on the STI Program—definition and overview of services, goals, and plans. Both customers and staff are pleased with the new system.

As a TQM initiative at **Langley Research Center**, the Photographic Section has initiated a "jury" (peer review) system that is designed to ensure the creation of high-quality photographic products.

The jury normally has four members: three lab photographers and one scientific and technical photographer. Jury members rotate every two weeks among

the staff of 25 Langley photography professionals on staff. Normally, the jury meets every day to critique slides, viewgraphs, black-and-white or color photography...whatever products are available. Because jury members convene regularly, there is no delay in maintaining pre-arranged production schedules. At the same time, the Langley photo products are now the highest quality the Section has ever produced.

The establishment of the TISD Conference Support Team (CST) in 1992 was one of the many activities which occurred at **Lewis Research Center** in its movement toward providing TQM-based operations. The team consists of three TISD staff members who represent the division to the customer and the customer to the division, and who work toward identifying realistic and mutually agreeable requirements for conference support—lead times dependent upon the work required, firm deadlines, clear statements of the support work required (documented in Conference Support Agreements), and clear understanding of communication requirements.

As at many NASA Centers, Lewis hosts, cosponsors, or participates in numerous conferences each year. The support required from TISD covers a broad range of services and products—from minimal production efforts for "smaller" items (such as meal tickets, receipts, and badges) to full-scale production efforts that require specialized services (e.g., editing, design, writing...) to prepare preprints, viewgraphs, brochures, exhibits, signs, etc.

In the past, Lewis conference organizers would plan and coordinate their conference support by various meetings with a large group of TISD staff members, who included management personnel and representatives from all the functional areas. The loosely planned meetings focused only on individual tasks, neglecting to view these as parts of a larger, total project. The CST approaches each conference as a single, large project which needs to be managed efficiently.

Beginning in early 1992, the CST worked with one Lewis customer to coordinate TISD's support for this year's HITEMP Review. The customer, who was delighted by the experience, later commented, "This was the first year I've ever been able to take a day off before the conference!"

A Bridge to the Future

TQM can be our bridge to a future filled with greater changes and more challenges than ever before.

At the NASA STI Program, we're making significant progress in our efforts to build a TQM culture. But that doesn't mean we are satisfied, nor that our work is complete.

TQM isn't designed to provide instant gratification. Neither will the cultural changes required to implement a totally committed TQM culture happen in a few weeks, a few months, or even a few years.

The important thing is—they are starting to happen. And with those changes come opportunities.

At the NASA STI Program, we're using TQM to refine our processes and build quality into our products, our services, and our infrastructure. We're gratified that Program changes are already translating into satisfaction among our current customers...and, as we look to the future, hinting at even greater satisfaction among a new generation of advocates and users of the NASA STI Program. •

A Glossary of STI Terms

Abstract—A summary of the main points covered in a publication. The abstract is accompanied by an adequate bibliographic description to enable the publication to be identified.

Bibliographic Information—Details concerning a publication that are sufficient to identify and locate it. These generally include the authors, title, publication date, report number, and corporate sources.

Cataloging—The procedure by which the bibliographic details of each STI document are extracted and entered into a data file.

CD-ROM—Compact Disk-Read Only Memory. A computer data storage device capable of holding massive amounts of information (more than 100,000 typewritten pages) in digital, optical formats. CD-ROMs are designed for use primarily with personal computers.

Citation—A reference to a text or part of a text identifying the document in which it may be found.

Data—A general term for numbers, digits, characters, and symbols that are accepted, stored, and processed by a computer. When such data becomes meaningful, then the data components become *information.*

Database—A collection of interrelated or independent data items stored together to serve one or more applications.

Document—A record that conveys information; originally an inscribed or written record, but now considered to include any form of information.

Field—The smallest unit of data in a record. NASA STI document records include such fields as accession number, author, title, subject, contract number, and country of origin.

Full-Text Searching—Online searching of the complete text of the document rather than just the bibliographic record. However, the term is also used sometimes to mean searching the complete text of the bibliographic record only.

Gateway—A link between networks.

Indexing—The process of assigning terms to a document that describe the subject content of that document.

Information—A collection of data in a comprehensible form that is subject to retention and dissemination.

Information Processing—The organization, manipulation, and distribution of information. Broader in meaning than "data processing."

Internet—A computer network that many Federal agencies, universities, and private companies use to exchange information worldwide.

Knowledge—The range of one's understanding of information pertaining to facts gained by investigation or experience. The NASA STI Program is dedicated to presenting information to NASA researchers in such a readily useable way that it will be added to their store of knowledge.

Machine-Aided Indexing—The use of computer processes that evaluate text phrases and suggest possible indexing terms for review by the (human) indexer. The process is rooted in a knowledge base that links natural language phrases to indexing terminology.

Machine-Readable—Information in a form that can be directly assimilated by computer input equipment.

Microfiche—A flat sheet of photographic film displaying an eye-readable header containing the title and other bibliographic information, and bearing in horizontal and vertical rows micro-images of the pages of a publication.

Micrographics—The storage of documents on, for example, microfiche, by a process of miniaturization.

Network—A communications system connecting various resources, which may include, on a local area or wide area network, individual workstations, printers, facsimile machines, etc., and on a regional, national, or international level the mainframe resources of corporations, universities, and government agencies. The interconnections between network nodes can include line telecommunications, satellites, and microwave communications.

Online—Pertains to applications and databases which are accessible on or from computer resources. With the NASA STI Program, RECON and ARIN are online information search and retrieval systems. Through the STI-developed NASA Access Mechanism, users will be able to access other online STI sources.

Open Literature—Refers to literature (articles, papers, books, etc.) that is published and distributed to the general public (as opposed to technical report literature and company reports, for example).

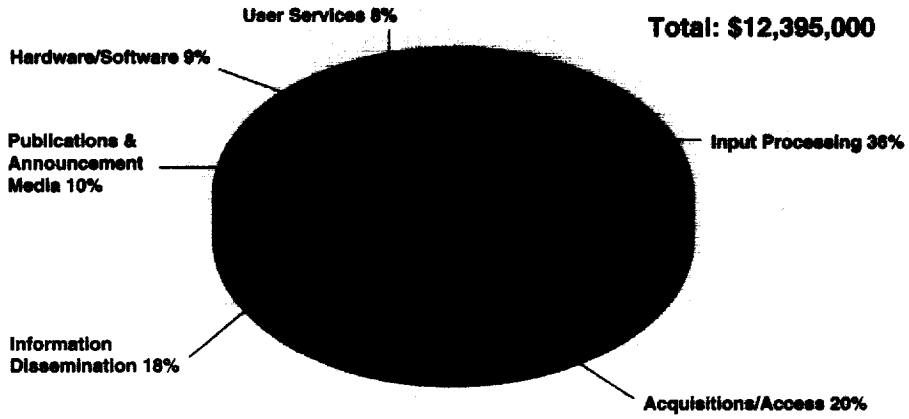
Record—A collection of related data elements or words (fields), treated as a unit. A bibliographic record describes a document.

Server—Typically, a computer that provides services to another computer (called the "client"). For example, to streamline access to the NASA STI Database, the Program is exploring the potential of the Wide Area Information Server (WAIS) as an interface to the NASA STI Database. Information from the NASA STI Database will be distributed to users on client computers via the Internet. The client/server model is often associated with networks, but it is also valid when the client and server are running as different processes on the same machine.

Thesaurus—A controlled vocabulary of related terms which covers a specific domain of knowledge; for example, the *NASA Thesaurus.*

How Our Money Is Spent

In the chart below, you can see how NASA STI Program Headquarters allocated its operating funds for fiscal year 1992.



STI Program Organizational Components

